



Quarantine Station North Head

Species Impact Statement

prepared for

North Head Sydney Pty Ltd

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Note - Parts of this report have been redacted by NPWS to remove sensitive site information

Executive Summary

Background

The Quarantine Station (Q Station) is owned by the NSW Department of Planning Housing and Infrastructure (DPHI) and managed by the National Parks and Wildlife Service (NPWS).

The lease for the site is currently held by North Head Sydney Pty Ltd (NHS), which is for cultural tourism, accommodation, conferences, and function purposes until 2027, with options to extend until 2050.

The current planning approval is due to lapse on 23 December 2024 and a new planning approval is being sought for the ongoing operation of Q Station beyond 2024, consistent with the current lease.

While there are no changes to current approved 'Key Site Activities' at Q Station, a range of amendments are proposed for the new planning approval. The proposed amendments aim to rationalise the requirements of the planning approval to provide a streamlined, contemporary and more workable approval for both NHS and NPWS. This would be achieved through the following:

- + Deleting conditions fulfilled by the previous leaseholder and/or are no longer relevant to the ongoing operation of the site.
- + Removing duplication of conditions.
- + Updating conditions to reflect:
 - o more recent management plans, titles and terminology,
 - o contemporary environmental standards, guidelines and best practice, and
 - o knowledge gained from the past decades of monitoring and data collection.

This Species Impact Statement (SIS) has been prepared to support the Review of Environmental Factors for approval from NPWS (the consent authority) for the ongoing operation of Q Station.

The requirement for preparing the SIS is triggered by parts of Q Station located on a declared area of outstanding biodiversity value (AOBV), formerly known as 'critical habitat' under the repealed *Threatened Species Conservation Act 1995*. The AOBV relates to critical habitat for the endangered little penguin (*Eudyptula minor*) population at Manly.

While the main focus of this SIS is the endangered little penguin (*Eudyptula minor*) population, other biodiversity values that are also considered include the following:

- + The endangered Long-nosed bandicoot (*Perameles nasuta*) population at North Head
- + Threatened ecological community Eastern Suburbs Banksia Scrub
- + *Posidonia australis* an endangered seagrass community
- + *Eucalyptus camfieldii* Camfield's stringybark
- + *Acacia terminalis* subsp. *terminalis* Sunshine wattle
- + *Pseudophryne australis* Red-crowned toadlet
- + *Cercartetus nanus* Eastern pygmy possum

Approach

Q Station and its surrounding environment are well researched through a range of past flora and fauna assessments and ongoing monitoring programs. Ongoing monitoring programs are undertaken by NPWS for the little penguin and the long-nosed bandicoot and by way of the North Head ecohealth reporting undertaken by the Harbour Trust (which includes parts of Q Station).

This SIS has drawn largely on a comprehensive review of site-specific reporting and available data (both historic and recent), supplemented by a review of auditing reports, scientific literature (as relevant to the subject site's biodiversity values), databases, aerial photographic interpretation and available mapping.

For each of the subject species, communities and populations an assessment of likely impacts has been undertaken based on the consideration of the factors set out in clause 7.6 of the *Biodiversity Conservation Regulation 2017* (BC Reg.), the NSW Fisheries threatened species guidelines (2008) and the Commonwealth of Australia's policy for Significance of Impacts Assessments (2013).

The assessment has focused on past and likely ongoing compliance with the current conditions of consent, which have mandated how operation of the facility for the past 18 years has been managed, monitored and audited.

Impact assessment

Threatened ecological communities

Five mapped plant community types (PCTs) within the subject site were found to be related to threatened ecological communities (TECs) listed under the NSW BC Act and/or the Commonwealth EPBC Act. These include:

- + Sydney Coastal Foreshores Gully Rainforest (PCT 3040) - the Commonwealth Littoral Rainforest and Coastal Vine Thickets of Eastern Australia TEC
- + Coastal Sands Littoral Scrub-Forest (PCT 3546) - NSW Bangalay Sand Forest TEC
- + Southern Sandplain Heath (PCT 3805) - Eastern Suburbs Banksia Scrub TEC (BC and EPBC Acts)
- + Sydney Coastal Sand Mantle Heath (PCT 3806) - Eastern Suburbs Banksia Scrub TEC (BC and EPBC Acts)
- + Sydney Coastal Sand Swamp Scrub (PCT 3922) - NSW Sydney Freshwater Wetlands TEC.

Various surveys and mapping of plant communities generally agree on the PCTs present within the subject site but vary in the extent of some PCTs. This is particularly relevant with recent State Vegetation Type Mapping (DPE, 2023), which substantially increases the extent of the Eastern Suburbs Banksia Scrub TEC.

The proposed ongoing operation of the facility will not adversely affect any of the above listed TECs. The past 18 years of operation have not resulted in any significant impacts and no vegetation clearing, or construction activities proximal to remnant bushland, would occur under this proposal.

Validation of the boundaries and condition of each PCT is recommended to ensure that:

- + The extent and type of each TEC is understood,
- + Whether diagnostic and condition thresholds are met to be considered nationally threatened, and
- + Inform management of the TECs and the threatened species known to be associated with each PCT.

Threatened flora species

Threatened flora species considered in this SIS include

- + *Eucalyptus camfieldii* (Camfield's stringybark) - Vulnerable under both the BC Act and EPBC Act.
- + *Acacia terminalis* subsp. *terminalis* (Sunshine wattle) - Endangered under both the BC Act and EPBC Act.
- + *Posidonia australis* (strapweed) a protected seagrass species and endangered population under the FM Act, and an endangered community under the EPBC Act.

The proposed ongoing operation of the facility will not adversely affect Camfield's stringybark and Sunshine wattle providing that they are identifiable to all employees and contractors working in the species' habitat areas.

Recent surveys and establishment of an updated seagrass monitoring program (Marine Pollution Research 2023) indicated that past disturbance of seagrass meadows around the Quarantine Wharf cannot be discounted, however more significant declines in seagrass meadows are evident beyond the subject site and attributed to wave action from the busy harbour beyond QS Beach.

The ongoing monitoring program (approved by NSW Fisheries) has been designed to discern between operation and external impacts.

Maritime regulations of watercraft speed limits and no-anchoring zones along with Quarantine Wharf berthing protocols are all designed to minimise disturbance and further impacts on seagrasses including *Posidonia australis*.

Posidonia australis in seagrass meadows at QS Beach does not currently meet the diagnostic and condition thresholds to be considered the endangered community under the EPBC Act.

Threatened fauna populations

Two threatened fauna populations occur within the subject site and surrounding environs:

- + The endangered population of Little Penguins *Eudyptula minor* at Manly
- + The endangered Long-nosed bandicoot (*Perameles nasuta*) population at North Head

Little penguin

The breeding success of Manly's little penguins is monitored annually with all accessible, known burrows and nests inspected fortnightly between July and January. A little penguin expert contracted by NPWS monitors the number of: active nests; breeding pairs; eggs laid and fledglings.

Continuing poor monitoring results overall show that the Manly little penguin breeding population has reduced considerably. The population has not been able to recover from the extensive losses to the breeding population from the fox predation in the pre-breeding season of June 2015.

The current low level of the population means there is little buffer against other impacts such as changes in oceanic conditions, which could impact individual breeding seasons or the long-term population.

The most recent monitoring report for the 2023-2024 season identifies that there are still far fewer penguins coming ashore to breed than in the years prior to the 2015 fox predation. The level of breeding declined over a number of years after the incursion but over the last few years, numbers appear to have reached a plateau, albeit at a much lower number.

In the years 2006 to 2014, breeding pairs were regularly in the range from 50 to 70 pairs, and active nests from 84 to 107. In the last five years, numbers of breeding pairs have ranged only from the low this year of 19, to 35 pairs.

It is considered likely now that the roughly 20 to 30 breeding pairs experienced over the last few years are the new normal base.

Monitoring has not indicated that the past operation of Q Station has been a causal factor in population decline of breeding population, despite the absence of breeding proximal to the Boilerhouse Restaurant building and outdoor eating area on QS Beach.

There are a number of data deficient areas from which potential or suspected threats cannot be conclusively linked to impacts on the little penguin in the study area. Instead, we are reliant on anecdotal or qualitative observations, and scientific research that is largely generated from interstate populations.

Filling the existing knowledge gaps with site-specific data collection will enable a more informed approach to managing little penguin habitat areas within the QS lease area and elsewhere in the AOBV areas.

Additional data collection and mitigation measures, including noise reduction measures and habitat enhancement, are provided.

Long-nosed bandicoot

Monitoring and management forms part of the work program of the North Head long-nosed bandicoot Recovery Team. Monitoring conducted by NPWS and other stakeholders such as the Sydney Harbour Trust indicates that the number of bandicoots remain relatively high compared to historical data and the sex ratio of individuals appears to be evening as at 2022 (in 2017-2021 the sex ratio was female biased).

Mortalities have not exceeded the minimum trigger levels set out in consent conditions and NPWS are satisfied that the current mortality monitoring program and triggers are appropriate.

Based on available data and compliance reporting, the ongoing operation of the facility is considered unlikely to adversely affect the long-nosed bandicoot population.

Threatened fauna species

The following threatened fauna species have been considered in the SIS:

- + *Pseudophryne australis* (the red-crowned toadlet) – Vulnerable under the BC Act
- + *Cercartetus nanus* (eastern pygmy possum) – Vulnerable under the BC Act

The red-crowned toadlet

The red-crowned toadlet was initially discounted as occurring in the subject site in the SIS supporting the original application for the facility (Gunninah 2001). Consequently, there are no current conditions or monitoring programs for the species.

The species has been detected at North Head by the Australian Wildlife Conservancy and in 2023 the species has been recorded both within and near the subject site.

As there hasn't been any monitoring for the species, an assessment of the facility's past operation, as a guide to assessing impacts on the proposed ongoing operation, is not possible.

Notwithstanding, the ongoing operation of the facility is considered unlikely to adversely affect species. Key impacts on potential habitat for this species would be altered hydrology and activities that decrease the quality of water. The subject site's hydrology will remain unchanged as will any activities that have a risk to impact on water quality.

It is however recommended that ongoing monitoring programs be expanded to incorporate red-crowned toadlet surveys.

Eastern pygmy possum

Translocation of the eastern pygmy possum to North Head (including the subject site) commenced in 2016, with 43 eastern pygmy-possums translocated in nest boxes between 2016 and 2022.

Ongoing monitoring indicates for the first time in 2022 the species is beginning to expand from initial release areas, thereby satisfying key success criteria associated with their reintroduction (AWC 2022).

The eastern pygmy possum was initially considered unlikely to be adversely affected by the proposed ongoing operation of the facility. This is largely due to the species having been introduced to the environment after operation of the facility had commenced. The pygmy possums introduced to nest boxes within or close to the subject site would have adapted to any potential indirect impacts (e.g., light, noise) from the facility's operation.

However, during the preparation of this SIS a mother and young were killed in a vehicle strike within the QS lease area. Monitoring must unfortunately be expanded to include the eastern pygmy possum to the existing long-nosed bandicoot road mortality monitoring program.

Conclusion

Based on the information available at the time of preparing this SIS the following is concluded:

- + The proposed ongoing operation of Q Station will not result in significant impacts on biodiversity values within or proximal to the subject site.
- + There is insufficient site-specific data to determine whether past operation of the facility has caused either wholly in part the cessation of little penguin breeding in habitat at the QS Beach and Boilerhouse locality.
- + The risk of any potential impacts having a significant impact on biodiversity values (within the subject site or proximal to the subject site) appears due to external factors that are beyond the control of NHS (e.g., climate change, wave action from the busy harbour, unplanned bushfires, recreational visitors by watercraft to Spring Cove).
- + The potential for the proposal to result in any impacts on biodiversity values will be continually monitored and scrutinised through ongoing compliance auditing and where necessary adaptively managed.

A range of recommendations are made in Section 8 of this SIS that are provided for integration into the existing monitoring programs and for consideration in consultation with relevant regulatory authorities.

The following recommendations are provided for integration into the existing monitoring programs and for consideration in consultation with relevant regulatory authorities:

- + Validation of the boundaries and condition of plant community types within the QS lease area to determine the extent and type of threatened ecological communities, guide how they should be managed, and understand whether diagnostic and condition thresholds are met to be considered nationally threatened. This should include the extent of weeds within these communities to assist QS landscape maintenance staff and bush regeneration contractors (if engaged) and inform TEC condition assessments.
- + Update staff induction contents to include red crowned toadlet and eastern pygmy possum and provide ongoing training and records requirement for all employees and contractors working in habitat areas of threatened species, communities and populations.
- + Ongoing monitoring programs be expanded to include the red-crowned toadlet.

- + In consultation with the NPWS little penguin recovery team investigation options to re-introduce nest boxes at QS Beach for the little penguin.
- + Consult with NSW TfNSW (Maritime) to:
 - improve signage in Spring Cove and enforcement of speed limits and anchoring in no-anchor zones (noting that aerial photographic interpretation indicates multiple infringements)
 - undertake educational/information campaigns to commercial operators and private boat owners to reinforce the sensitivity of the Spring Cove environment.

Based on the information available at the time of preparing this SIS the following is concluded:

- + The proposed ongoing operation of Q Station will not result in significant impacts on biodiversity values within or proximal to the subject site.
- + The risk of any potential impacts having a significant impact on biodiversity values (within the subject site or proximal to the subject site) appears due to external factors that are beyond the control of NHS (e.g., climate change, wave action from the busy harbour, unplanned bushfires, recreational visitors by watercraft to Spring Cove).
- + The potential for the proposal to result in any impacts on biodiversity values will be continually monitored and scrutinised through ongoing compliance auditing and where necessary adaptively managed.

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Shortened form

AWC	Australian Wildlife Conservancy
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BC Reg.	NSW <i>Biodiversity Conservation Regulation 2017</i>
Biosecurity Act	NSW <i>Biodiversity Security Act 2015</i>
CEEC	Critically Endangered Ecological Community
CoPA	Conditions of Planning Approval
DACMP	Detailed Area Conservation Management Plan
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DPHI	NSW Department of Planning Housing and Infrastructure
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW)
EPBC Act	<i>Commonwealth Environment Protection Biodiversity and Conservation Act 1999</i>
FM Act	NSW <i>Fisheries Management Act 1994</i>
IBRA	Interim Biogeographic Regionalisation of Australia
IMAMS	Integrated monitoring and adaptive management system
LEP	Local Environment Plan
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NPWS	National Parks and Wildlife Services
PCT	Plant Community Type
REF	Review of Environmental Factors
SAII	Serious and Irreversible Impact
SEARs	Secretary's Environmental Assessment Requirements
SEPP	NSW State Environment Protection Policy
SIS	Species Impact Statement
SSD	State Significant Development
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection

1. Introduction

1.1 Background

The Quarantine Station is owned by the NSW Department of Planning Housing and Infrastructure (DPHI) and managed under the National Parks and Wildlife Service (NPWS). DPHI is the parent organisation of NPWS and regulates matters relating to heritage, pollution, native vegetation, biodiversity and National Parks.

Planning approval (MP08_0041) was granted in 2003 for the 'North Head Quarantine Station Conservation and Adaptive re-use Proposal' with NPWS and Mawland as co-proponents. In 2006 the site was leased to Mawland for the adaptation of the site and operation of a tourist facility "Q Station", accommodating conferences, weddings, tours and education programs, and overnight stays. Mawland operated the facility and ran the day-to-day activities onsite up until 2022.

The lease for the site is currently held by North Head Sydney Pty Ltd (NHS). This lease was granted under Section 151A of the National Parks and Wildlife Act 1974 (NPW Act).

NHS is currently seeking approval for the ongoing operation of Q Station from beyond 2024 until 2050.

This Species Impact Statement (SIS) has been prepared to support the Review of Environmental Factors (REF) prepared by NHS for approval from NPWS (the consent authority).

1.2 Reason for preparing a Species Impact Statement

A Species Impact Statement is required to support a REF where it is found that the proposed development or activity is likely to have a significant impact on a threatened species or population or endangered ecological community.

For the purposes of Part 7 of the *Biodiversity Conservation Act 2016* (BC Act), Section 7.2 (1) states that development of an activity is likely to significantly affect threatened species if :

- + *it is carried out in a declared area of outstanding biodiversity value.*

Declared area of outstanding biodiversity values (AOBVs) were formerly known as 'critical habitat' under the repealed Threatened Species Conservation Act 1995.

The requirement for preparing a Species Impact Statement (SIS) is therefore triggered by parts of Q Station located in critical habitat for the endangered little penguin (*Eudyptula minor*) population at Manly.

Other protected matters that are considered in the SIS include:

- + The endangered Long-nosed bandicoot (*Perameles nasuta*) population at North Head
- + Threatened ecological community Eastern Suburbs banksia scrub
- + *Posidonia australis* an endangered seagrass community under the FM Act
- + Threatened species:
 - o *Eucalyptus camfieldii* Camfield's stringybark
 - o *Acacia terminalis* subsp. *terminalis* Sunshine wattle
 - o *Pseudophryne australis* Red-crowned toadlet
 - o *Cercartetus nanus* Eastern pygmy possum

The requirements of a SIS are set out in clause 7.6 of the *Biodiversity Conservation Regulation 2017* (BC Reg.). The following requirements are addressed for each of the above threatened population, community and species in Sections 4-6:

- + General description
- + Conservation status
- + Consideration of key threats and threatening processes
- + Current monitoring programs and results
- + Conditions of Planning Approval (where applicable)
- + Impact assessment
- + Mitigation measures

With Sections 7 to 9 addressing the following SIS requirements:

- + Assessments of Significance of likely effect or proposed ongoing operation of the facility
 - NSW Test of Significance
 - NSW Fisheries Significance assessment
 - MNES Significance of Impacts
- + Conclusions and Recommendations
- + Additional Information
 - Qualifications and experience
 - Other approvals required for the development or activity
 - Licencing matters relating to conducting surveys

1.3 Methods of Assessment

1.3.1 Approach

Q Station and its surrounding environment are well researched through a range of past flora and fauna assessments and ongoing monitoring programs. Ongoing monitoring programs are undertaken by NPWS for the little penguin and the long-nosed bandicoot and by way of the North Head ecohealth reporting undertaken by the Harbour Trust (which includes parts of Q Station).

The scope of this SIS has therefore not included any additional targeted flora or fauna surveys¹. Instead relying on a comprehensive review of site-specific reporting and data (from ongoing monitoring programs) supplemented by a review of scientific literature (as relevant to the subject site's threatened species, communities and populations).

1.3.2 Information sources

The following information sources have been used:

- + Spatial data
 - Nearmap EPSG7856_Date20240312_Lat-33.810832_Lon151.293005
 - Nearmap EPSG7856_Date20240225_Lat-33.816259_Lon151.289314
 - Nearmap EPSG7856_Date20230620_Lat-33.810936_Lon151.295273
 - NSW National Parks and Wildlife Service (NPWS) All Managed Land shapefile
 - Sydney-CONT-AHD_56_2m shapefile
 - SydneyMetroArea_v3_2016_E_4489 (OEH 2016)

¹ Site inspections of the the long-nosed bandicoot habitat and little penguin were undertaken 19 October 2023, 27 November 2023, -8 February 2024.

- SVTM_NSW_Extant_PCT_vC2_0_M2_0_106 (DPE 2023)
- Estuary Macrophytes (DECCW 2010)
- Soil Landscapes of the Sydney 1:100,000 Sheet map, Ed. 4, (DECCW, Chapman et al., 2009)
- + Approvals and operational documents
 - Species Impact Statement - Adaptive Reuse Proposal (Gunninah 2001)
 - Environmental Impact Statement (Manidis Roberts 2003)
 - Joint Determination Report (2003) Clause 243 Report under Part 5 of the EP&A Act
 - Environmental Impact Assessment MP08_0041-Mod-3 (Linchpin, 2015)
 - Consolidated Consent as modified by MP08_0041-Mod-3 (DPE, 2018)
 - Quarantine Station North Head Management Plans:
 - Conservation Works Program (Paul Davies Pty Ltd, 2006)
 - Environmental Management Plan (DEC, 2005)
 - Integrated monitoring and adaptive management system (Mawland Construction, 2006)
 - Heritage Landscape Management Plan (Thompson Berrill Landscape Design Pty Ltd, 2006)
 - Integrated monitoring and adaptive management system (Mawland Construction Pty Ltd 2006)
 - Infrastructure Control Plan - Part 1 (Mawland Construction Pty Ltd 2008)
 - Predator and Pest Management Plan (NPWS, 2008)
 - Audit compliance reports completed for 2006-2011 (Graham A Brown & Associates, 2011); 2011-2018 (SNC-Lavalin, 2018); and 2018-2021 (Wolfpeak, 2022)
 - NSW National Parks & Wildlife Service (2004) Fire Management Plan Sydney Harbour and Botany Bay (La Perouse Precinct)
 - NSW National Parks & Wildlife Service (2017-2022) Monitoring Report 2017-2022. Quarantine Station – Sydney Harbour NP Integrated Monitoring Program.
- + Biodiversity
 - *Acacia terminalis terminalis* (Sunshine Wattle) National Recovery Plan (DECCW 2010)
 - Eastern Suburbs Banksia Scrub Endangered Ecological Community Recovery Plan (DEC 2004)
 - *Eucalyptus camfieldii* Conservation Advice (Commonwealth of Australia 2008)
 - Flora of North Head (Skelton et al, 2003) prepared for the Sydney Harbour Federation Trust
 - Littoral Rainforest and Coastal Vine Thickets of Eastern Australia Conservation Advice (Commonwealth of Australia 2015)
 - Manly Little Penguin Recovery Program Monitoring Reports (NPWS, 2003-2024)
 - North Head Ecohealth Reporting (Australian Wildlife Conservancy, 2020, 2021, 2022)
 - Seagrass Monitoring Program 2022/2023 (Marine Pollution Research Pty Ltd, 2023)
 - Status of the Endangered Population of Little Penguins *Eudyptula minor* at Manly (NPWS, 2007)
 - Scientific Committee Final Determinations (Commonwealth, NSW & Fisheries (as relevant)
 - Little penguin *Eudyptula minor* Manly Population Recovery Plan (NPWS 2000)

+ Assessment guidelines

- Commonwealth of Australia (2013) Matters of National Environmental Significance - Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999.
- Commonwealth of Australia (2018) *Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion
- NSW Department of Primary Industries - Fisheries (2008) Threatened species assessment

Additional literature reviewed and referenced throughout this document is provided in Section 9.

2. The Proposal

2.1 Overview

The operation of the subject site is undertaken in accordance with the current planning approval, which was granted by the NSW Minister for the Environment on the 23 December 2003 and later modified in 2018 (following over ten years of operation). The current planning approval is due to lapse on 23 December 2024. The operation of the site is subject to a lease for cultural tourism, accommodation, conferences, and function purposes until 2027, with an option to extend until 2050.

On this basis, the proposed activity seeks:

- + To obtain a new planning approval under Part 5 of the EP&A Act and Clause 171 of the EP&A Regulation for the ongoing operation of Q Station beyond 2024, consistent with the current lease.
- + Rationalise the requirements of the planning approval to provide a streamlined, contemporary and more workable approval for both NHS and NPWS.

There is no proposed change of use from the current approved ‘Key Site Activities’ as outlined in the current conditions of approval nor are any physical works proposed.

A range of physical works are likely to be required over the course of the lease period to ensure facilities are maintained at an appropriately high standard across time, and that the site’s unique qualities and significance are protected. These works will be subject to separate planning approval.

2.2 Conditions of Planning Approval

While the current Key Site Activities allowed at Q Station will remain unchanged, a range of amendments are proposed which include

- + Deletion of obsolete conditions (i.e., previously fulfilled by Mawland during the establishment of the facility and that which are no longer applicable)
- + Update conditions to reflect more recent management plans, titles and terminology

The proposed modifications to the conditions in Table 2-1 have been identified by Keylan Consulting and other relevant stakeholders.

Table 2-1. Proposed changes to conditions

Existing Condition		Proposed amendment
Water-based access		
138	<p>The ferry service between Manly and the Quarantine Station site shall:</p> <ul style="list-style-type: none"> + commence within 6 months of the commencement date or, if this cannot be achieved due to circumstances beyond the reasonable control of the co proponents, within such other time as the DEC may approve; + generally, arrive and depart between the hours of 9:00 am and 11:00 pm respectively; + be limited to a maximum of one movement per hour, after sunset, between July and February inclusive, to reduce the potential for impacts 	<ul style="list-style-type: none"> + Amend term “ferry” to “water-based access”, as water-based access to the site is broader than just ferry. + Amend to reflect 2018 Travel and Access Plan and REF traffic/transport report.

Existing Condition		Proposed amendment
	<p>on the Little Penguin population. A maximum of 20 movements in one day may occur at other times to encourage water-based access to the site; and</p> <p>+ except for extreme weather events and maintenance periods, be provided on an hourly basis during the peak periods of visitor activity.</p>	
139	<p>The co-proponents shall undertake all practicable measures to ensure that:</p> <p>+ within 3 years of the commencement date, the proportion of visitors accessing the site by the ferry is 40% or greater; and</p> <p>+ within 5 years of the commencement date, the proportion of visitors accessing the site by ferry is between 40% - 50% and stays at this level, or greater, for the life of the project</p>	<p>+ Mode share % to reflect 2018 Travel and Access Plan and REF traffic/transport report</p>
140	<p>The wharf facility shall be used in accordance with the following provisions:</p> <p>a. the wharf shall only to be used for the casual berthing of the vessel “The Jenner”, or an appropriate vessel of similar dimensions and loadings. Assistance must be provided to persons with mobility limitations;</p> <p>b. the ferry must always dock at the head of the wharf (ie. The north-western end) until such time as any future alterations to the wharf have been assessed and approved by the relevant authorities;</p> <p>c. the ferry shall not moor at the wharf when not in active use (ie. overnight);</p> <p>d. the ferry shall not moor at the wharf during unsuitable weather events (eg. storms, strong winds, large swells)</p> <p>e. the co-proponents shall ensure that there is no access to the wharf as part of the activity by recreational or commercial vessels until such time as any proposed access arrangements for these vessels have been assessed and approved by the relevant authorities. The wharf shall include signage to indicate that access is prohibited unless authorised by the Waterways Authority and DEC; and.</p> <p>f. There shall be no vessel access on the south-western side of the wharf, parallel to Cannae Point</p>	<p>a. Amend condition to permit commercial and recreational vessels similar to the Jenner or smaller – as the Jenner was privately owned by former operators</p> <p>b. No change</p> <p>c. No change</p> <p>d. No change</p> <p>e. Unsuitable weather events should be defined somewhere to reduce liability risk. Guidance such as winds >xx knots</p> <p>f. No change</p>

Existing Condition		Proposed amendment
141	<p>Minor variations to the provisions of condition 140), a), b) and c) above may be approved by the Waterways Authority and the DEC, upon receipt of an application from the co-proponents. The application shall address, but not be limited to, safe berthing/mooring arrangements, disabled visitor access, potential impacts on seagrasses (eg. from overshadowing and propeller wash) and Little Penguins.</p> <p>Any significant variations to these conditions, and any variations to condition 140) e), shall (if necessary) require a separate application and approval under Part 5 of the Environmental Planning and Assessment Act 1979 and other relevant legislation.</p> <p>The Waterways Authority and DEC shall consult with NSW Fisheries before any variations are approved</p>	<p>Condition to be updated to reflect current departmental names</p>

2.3 Current Site Operations and Daily Activities

Table 2-2 provides an outline of the site operations that occur on a regular basis and Figure 3-1 illustrates the locations of buildings and operational areas referenced.

Table 2-2. Current site operations

Operation
<p>Visitor access</p> <p>There are 2 car parks at Q Station:</p> <ul style="list-style-type: none"> + CP1 at reception/entrance with 120 spaces for all visitors and hotel guests + CP5 within the site with 56 spaces for Q Station vehicles, staff and guests <p>For most arriving visitors parking is in CP1. Access into the site is then either walking or use of the Q Station shuttle bus.</p> <p>There is a boom gate at reception (A26), to manage vehicle access into the site.</p> <p>Staff are permitted to drive on site to access CP5 for staff parking and drive Q Station vehicles as necessary to their position.</p> <p>Contractors are permitted to drive on site when necessary.</p> <p>Guests staying in cottages can drive and park in designated parking areas adjacent to their cottage.</p> <p>If a driver is permitted to drive on site (i.e. staff, contractor or cottage guest) a site induction must be completed prior to entering.</p> <p>The Q Station shuttle provides a free transport in and out of Manly. This is timetabled and details are found on the Q Station website.</p> <p>Arrival to the site via ferry is not currently possible.</p>

Operation

Groups are encouraged to visit Q Station via private coach or bus. Small buses up to 22 seats with private groups attending a Q Station event or tour are permitted to drive into the site where the group has limited mobility. These small buses are escorted by a Q Station shuttle into the site.

Visitor management

Site capacity

The current capacity limit for the site has been set by the current CoPA to be optimally 315pax with a maximum of 600 pax at any one time. This includes staff and guests.

Two community open days are held each year. On each day a program of free tours, talks and activities is available for the community to book and attend.

The QSCCC meets at Q Station 4 time a year. It consists of an independent chair, representatives from NHS, NPWS and local community stakeholder groups.

Visitor Centre and Museum

Building A14-17 within Wharf precinct houses a free Quarantine Exhibition, Tours Desk, café and public toilets. The Tours desk is staffed 10am-4pm every day for visitor information & enquiries, assistance and tour booking. The café is open from 8am every day serving coffee, light meals and snacks.

Tours

The current tours on offer at Q Station can be divided into history, ghost and education programs. All education, public and private tour information can be found on the Q Station website. Bookings for public tours can be made through the website. Changes to specific tour schedules and content are based on demand and seasonality, however in general the tours run as follows:

Quarantine Wander History Tour – 11am daily

Disease and Burial History Tour – after dark

Ghostly Encounters Tour – 2.5 hours Wednesdays

Ghost trackers Family Tour – 2 hours Friday & Saturday

Paranormal Investigation – 3.5 hours Thursday evening

Private tours for in house conferences and other external social or corporate groups are also available. Booking requests managed individually. The site held 19000 tour guests in 2023.

Education programs

The site holds educational programs for primary and secondary students. These programs involve exploring the natural and built environment, handling artefacts, following paths of migration on large maps, experiencing past technologies, interacting with primary sources, playing games and hearing stories.

The Environment and Cultural Centre (A9 & A11) is also used as part of educational programs offered at the site. Groups are able to stay in the hotel accommodation. Buildings commonly used are P21, P22 or P23 or cottages, however this depends on the numbers, gender, staff to student ratio and other requirements of the school.

Conferences, functions and events

Q Station hosts a range of conferences, functions and events over the year, with the potential of up to 45% of total revenue being generated in this way. The follow 11 buildings are available for meetings and functions: P3, P7, P10, P12, P15, P16, P27, A2 & H1A.

Operation

A6:

The Boilerhouse Kitchen and Bar is a restaurant which operates out of building A6. Operating hours are outlined below:

Opening times	Lunch
Mon – Tues: Closed	12pm - 3pm Saturday and Sunday
Wed – Fri: 4.00pm-9pm	Dinner
Sat: 12pm – 9pm	5.30pm – 9pm Wednesday to Saturday
Sun: 12pm – 5pm	

The Engine Room bar at the beachside end of A6 offers a casual dining option for lunch, dinner or refreshments. Opening hours are as follows:

Friday 4pm-9pm

Saturday & Sunday 11am -5:30pm

The kitchen for the Boiler house and Engine Room bar is located within A6.

P12 & P13:

A restaurant is located in building P12. Food preparation is conducted in neighbouring building P13.

This restaurant/food preparation provided buffet breakfast for guests every morning from 7am.

A14 & A17:

A café (known as the 'Wharf Café') is located inside A14-17 and forms part of the Visitor Centre complex in the Wharf precinct.

Opening hours are Sunday-Tuesday 8am-5pm and Wednesday-Saturday 8am-4pm.

Food preparation for this café is completed in P13 and then delivered to the café each day.

A20:

A kitchen is located within A20. This kitchen is used on demand only for events and functions.

Q Station vehicles are used to transport food to all locations outside of immediate venues.

Staff

There are currently 140 staff employed at the site. This includes a mix of permanent full time and part or casual roles.

Environmental

Maintenance/conservation

- + Specific maintenance tasks on site are logged through the in-house Protel system.
- + Daily report tasks are attended to by the maintenance team in the first instance.
- + Specialised trades e.g. electrical, plumbing services are contracted when appropriate.
- + Regular use and inspection of buildings and infrastructure also informs ongoing maintenance requirements such as painting of buildings, drain clearing, road potholes.
- + Repairs to buildings and infrastructure are carried out in line with CWP guidelines.

Operation

- + Mown areas are subject to ongoing grass cutting, weeding and other gardening tasks are predominately carried out in the immediate garden beds adjacent to buildings or on the periphery of the mown areas.
- + Pest control

The continuation of the abovementioned site operations and activities is sought as part of approval application.

These activities will continue to be undertaken in accordance with the management and mitigation measures listed within the relevant Site Wide Plans.

Section 7 provides an assessment of the operational activities and associated Site Wide Plans.



Figure 2-1. Operational locations

2.4 Consideration of alternatives

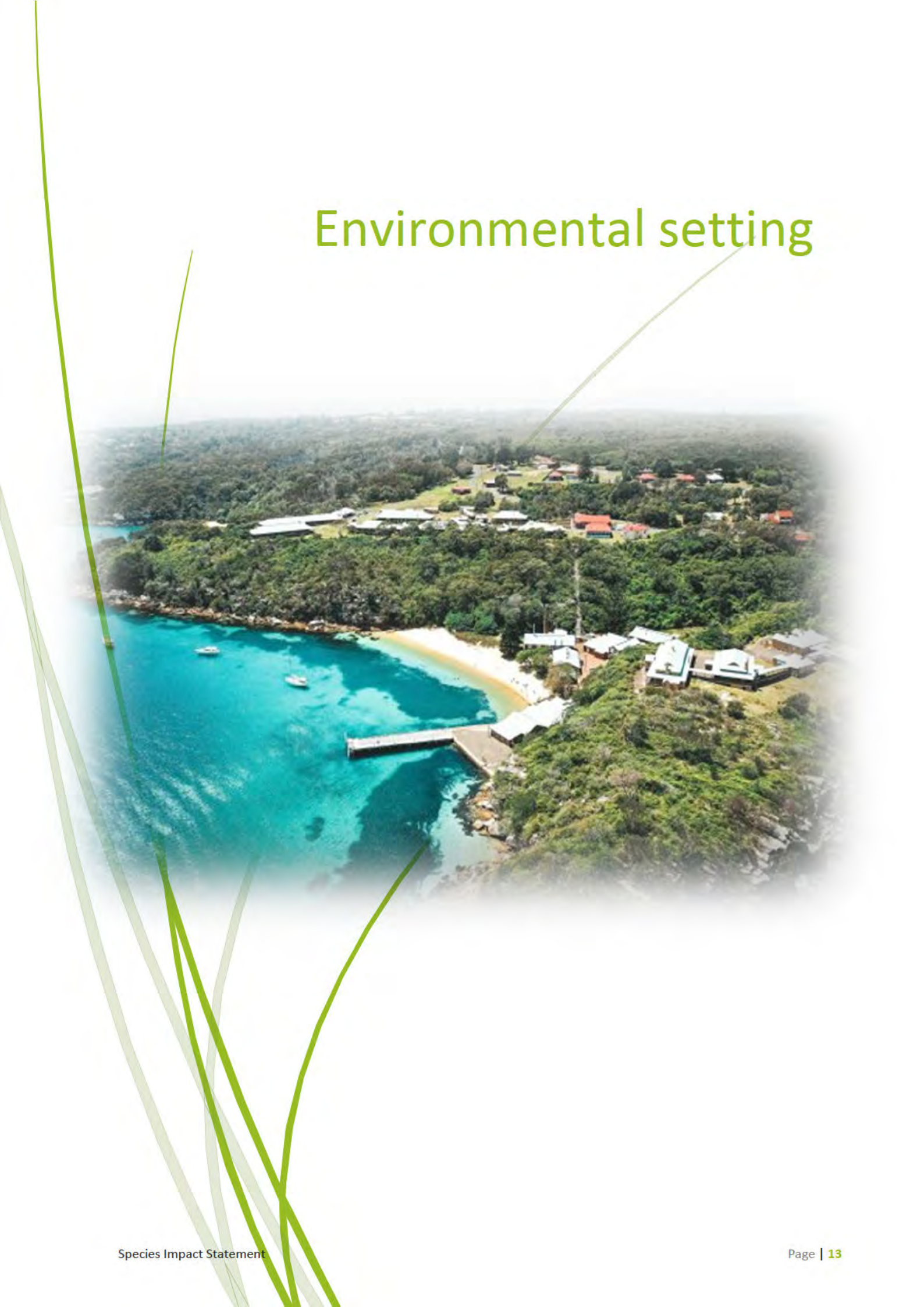
Given the current planning approval expires in December this year, there is no alternative to the proposed activity, other than a 'do nothing' option.

Under a 'do nothing' option, the operations at the site would cease after 23 December 2024. This would prevent the site from operating for cultural tourism purposes, despite the current lease enabling this until 2050.

It would also mean an end to current public access to and operations on the site which have been made possible by the significant investment that has been undertaken in conserving the site's heritage and other improvements to the site since the original planning approval. This would also prevent the ability for the site's culture and heritage to be understood and interpreted by the public.

With specific relevance to the site's biodiversity values, a 'do nothing' option would ensure a lack of financial security for the ongoing conservation of the facility's biodiversity values and an increasing demand on public (NPWS) finances.

Environmental setting



3. Site description

3.1 Subject site

The subject site is defined as the 27.5 hectares (ha) within the boundaries of the Q Station (also referred to as the QS lease area). As shown in Figure 3-1 and Figure 3-2, the subject site is situated on the western side of North Head, on a natural amphitheatre of land centred on QS Beach. The area is fringed by a continuous tract of bushland on the north, south and eastern sides, and by the harbour on the western side (NSW State Heritage Register, 2024).

QS Beach is 200 m long, faces northwest into North Harbour, and is hemmed in by rocks at each end, together with a seawall and wharf at the southern end. Currently, formal access to the beach is via the visitor's centre at the main entrance (on foot or by shuttle bus), although many visitors come by boat, kayaks and paddle boards.

Vegetation within the bushland reflects North Head's sandstone geology but varies considerably with elevation, which descends from 76m AHD in the northeast and 50m AHD on the southeast down to 0m at QS Beach (see Figure 3-1).



Figure 3-1. Subject site (Nearmap imagery 25/02/2024)

3.2 Surrounding Land Uses

As shown in Figure 3-2, the Sydney Harbour National Park includes and extends to the north, south and east of Q Station and encircles the North Head Sanctuary and North Head Wastewater Treatment Plant.

In 1984, ownership of the Q Station was transferred from the Commonwealth to the State Government and it was reserved as part of Sydney Harbour National Park.

The North Head Sanctuary has been retained by the Commonwealth and is managed by the Sydney Harbour Federation Trust (or Harbour Trust).

Other land uses proximal to the Q Station include Stores Beach, the Australian Institute of Police Management (AIPM), Collins Beach, the former Manly Hospital site, St Paul’s Catholic College, Little Manly Point and Little Manly Beach (see Figure 3-2).

Q Station is accessed via an internal road that connects to the North Head Scenic Drive. Prior to Q Station the scenic drive provides access to the AIPM, Collins Beach and the Barracks Precinct of the North Head Sanctuary (see Figure 3-2).

Beyond Q Station the scenic drive provides further access to the North Head Sanctuary and the scenic lookouts within the Sydney Harbour National Park (see Figure 3-2).

For the purposes of this SIS, the study area includes Sydney Harbour National Park (to the north, east and south of the QS lease area), the North Head Sanctuary, the AIPM, Spring Cove and Little Manly Cove (see Figure 3-2).



Figure 3-2. Subject site and surrounding land

3.3 Landscape description

The diversity, abundance and distribution of the vegetation that occurs on North Head is a result of the topography, geology, soil landscapes, hydrology, salt spray, fire history and anthropogenic disturbance.

3.3.1 IBRA regional context

The study area is in the Pittwater subregion of the IBRA Sydney Basin (SB) region, which comprises Triassic Hawkesbury Sandstone with thin ridge cappings of Ashfield Shale, Narrabeen sandstones exposed in valleys and along the coast and Quaternary coastal sands.

Characteristic landforms include (but are not limited to) small beach, dune and lagoon barrier systems and steep coastal cliffs and rock platforms.

3.3.2 Geological context

Sydney Harbour is made up of mostly sandstone and shale formed during the Triassic period (about 220 million years ago). These formations were later raised to their present heights by earth movements, starting in the Jurassic period, (200 million years ago). During this time great cracks formed and molten lava rose up through the rocks to form volcanic vents, these then cooled and hardened to form dykes of basalt. Remains of basalt dykes occur at North Head.

The eastern part of the harbour, including the study area, is predominantly Hawkesbury sandstone. Sandstone is a very hard rock that tends to break away in large blocks leaving the boulders and vertical cliffs that characterises the Sydney coastline.

To the west the harbour is predominantly made up of Ashfield Shale. Shale is not as hard as sandstone and tends to weather and erode without forming boulders or cliffs. Consequently, the western shoreline of Sydney Harbour tends to be much flatter and devoid of rocky outcrops.

Along some parts of the harbour there are some low-lying areas of sand that has been deposited by water (alluvium) running between hills of sandstone. Particularly high areas such as North Head, were once islands now joined to the mainland by sand spits such as the Corso area of Manly.

North Head is formed from Triassic units of the Sydney Basin sequence intruded by dykes of probable Jurassic age. North Head is an outlying remnant of the Hornsby Plateau from which it has become isolated due to erosion. It is in fact a tied island, connected to the mainland only by the sand spit (tombolo) on which Manly village is now located (Skelton et al., 2003).

Wind deposited sand dunes made up of white quartz sand cover much of the central section of North Head, generally above the 80m contour and beyond the subject site. Two basaltic dykes have been identified at North Head, a larger one running between the cliffs west of Old Man's Hat and the southern face of Cannae Point and a smaller one exposed in the cliff south of Blue Fish Point. Both dykes strike approximately NW-SE (Osborne & Osborne 1999).

3.3.3 Soil landscapes

Mapping of the 1:100 000 map sheet (Chapman and Murphy 1989) identifies three soil landscapes within the subject site: Lambert; Gynea; and North Head (Table 3-1).

As shown in Figure 3-3 most of the subject site overlies the Lambert soil landscape, with the vegetated slopes leading to and including QS Beach overlying Gynea soil landscape, and land at higher elevation surrounding the entrance road overlying the North Head soil landscape.

Table 3-2 summarises key characteristics of each soil landscape, which influence the plant communities present and, in turn, the habitat provided for local fauna and visiting fauna species.

Table 3-1. Soil landscapes

Lambert Erosional	These shallow soils occur on the exposed edges of North Head around the Aeolian dunes. They are characterised by discontinuous earthy sands and yellow earths on crests and inside of benches, shallow siliceous sands/lithosols on leading edges, shallow to moderately deep leached sands, grey earths and gleyed podzolic soils in poorly drained areas and localised yellow podzolic soils associated with shale lenses (Chapman and Murphy 1989). Limitations include very high soil erosion hazard, rock outcrop, seasonally perched water tables, shallow, highly permeable soil and very low soil fertility.
GyMEA Erosional	These soils occur on the northwest side of North Head. They are characterised by shallow to moderately deep yellow earths and earthy sands on crests and inside of benches, shallow siliceous sands on leading edges of benches, localised gleyed podzolic soils on shale lenses, shallow to moderately deep siliceous sands and leached sands along drainage lines (Chapman and Murphy 1989). Limitations include localised steep slopes, high soil erosion hazard, rock outcrop, shallow highly permeable soil and very low soil fertility.
North Head Aeolian	These soils occur along the higher central area of North Head and are characterised by deep podzols overlying bedrock, buried podzols, buried sandstone soils and occasional siliceous sands and yellow podzolic soils (Chapman and Murphy 1989). Limitations include extreme wind erosion hazard, high water erosion hazard, non-cohesive and highly permeable soil, and very low soil fertility.

Thompson Berrill Landscape Design Pty Ltd (2006) describe the sandy podsols of North Head with a distinct leached A2 horizon. These sands present a significant wind and water erosion hazard, particularly in high use areas below the Third-Class Precinct. The western side of North Head grading down towards Spring Cove and QS Beach containing shallow, infertile soils with a high erosion hazard. Bare rock outcrops are common.

Table 3-2. Soil landscapes

Soil type	Landscape	Vegetation
Lambert (erosional process)	<p>Geology: Hawkesbury Sandstone - medium to coarse-grained quartz sandstone with minor shale and laminite lenses.</p> <p>Topography: Undulating to rolling low hills. Local relief 20–120 m and slopes <20%. Broad convex crests and plateau surfaces.</p> <p>Gently to moderately inclined side slopes, often associated with small hanging valleys.</p> <p>Characteristic sandstone bedrock that outcrops as wide benches (10–100 m), with broken scarps 1–4 m high.</p> <p>Small, poorly drained seepage areas are common.</p>	<p>Predominantly uncleared open-heathlands, closed-heathlands and scrublands, with patches of low eucalypt woodland. The heathlands and scrublands are often exposed to strong winds.</p> <p>Shallow, poorly drained soils fluctuate between being saturated or dry. Isolated lines and patches of trees are occasionally associated with joint crevices. <i>Allocasuarina distyla</i> and/or <i>Banksia ericifolia</i> are usually dominant.</p> <p>Other shrubs such as <i>Hakea teretifolia</i> may be locally dominant in areas subject to seepage or prolonged saturation. Associated shrubs include various <i>Grevillea</i> spp., <i>Konza</i> spp., <i>Pultenaea</i> spp., <i>Leptospermum</i> spp. and <i>Epacris</i> spp.</p>
GyMEA (erosional process)	<p>Geology: Hawkesbury Sandstone, which is a medium to coarse-grained quartz sandstone with minor shale and laminite lenses.</p>	<p>Low, dry sclerophyll open woodland dominates ridges and upper slopes. Common species include red bloodwood, yellow bloodwood, scribbly gum, brown stringybark and old man banksia.</p>

Soil type	Landscape	Vegetation
	<p>Topography: Undulating to rolling low hills with local relief 20–80 m and slopes of 10–25%. Sideslopes with narrow to wide outcropping sandstone rock benches (10–100 m), often forming broken scarps of <5 m.</p>	<p>On the more sheltered slopes, black ash, Sydney peppermint and smooth-barked apple are common tree species. The dry sclerophyll understory consists of shrubs from the families Epacridaceae, Myrtaceae, Fabaceae and Proteaceae.</p>
<p>North Head (aeolian process)</p>	<p>Geology: Elevated, undulating to rolling rises of aeolian reworked dune fields.</p> <p>Topography: Local relief to 5 m; slopes 5–15%. Rock outcrop is usually absent. Dunes and swales have often been reworked and may be difficult to distinguish. Drainage is mostly sub-surface.</p>	<p>Mostly cleared heathland and scrub. Common species include Sydney golden wattle, prickly Moses, coastal tea tree, native rosemary, and coastal heath.</p> <p>Occasionally eucalypt woodland is located in less exposed areas. These areas are usually dominated by old man banksia, smooth-barked apple and Sydney peppermint.</p>

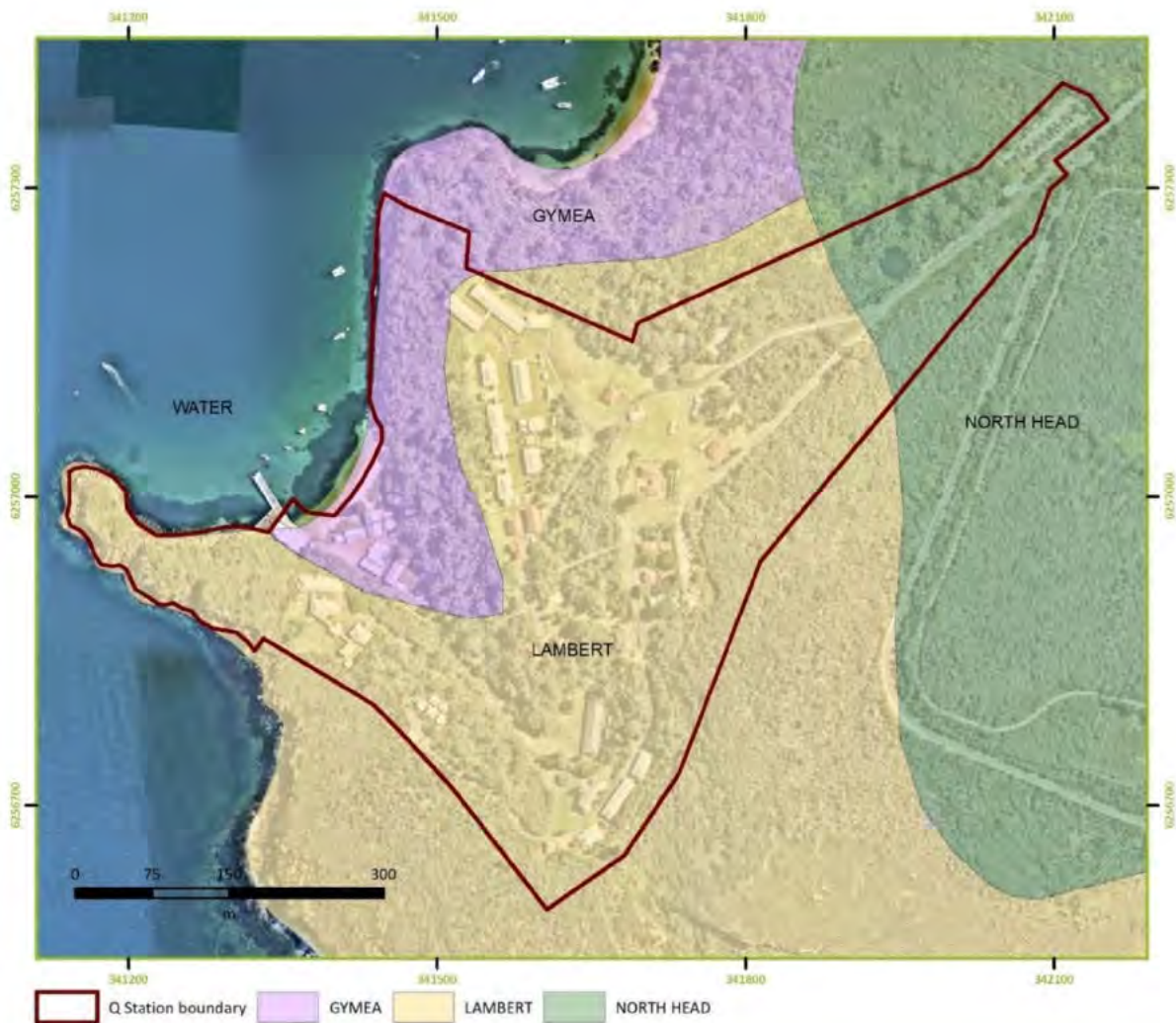


Figure 3-3. Soil landscapes

3.3.4 Hydrology

3.3.4.1 Background

Availability of water is a major factor influencing the distribution of many plant species on North Head. There are no rivers, lakes, lagoons or other major water features on the headland. Due to the sand dunes, clay patches and less permeable layers of sandstone, there are many springs that seep out on the cliff face on the eastern side and occasional wet patches on the western side, including the subject site (Skelton et al., 2003).

Drainage from the Aeolian sand deposits capping the headland is mostly subsurface, with very little surface run-off. In general, the soils of North Head have little water holding capacity. Within the site a sandy swamp occurs on the upper western slope proximal to the subject site (Skelton et al., 2003).

Prior to colonial occupation, a large water catchment covered a significant portion in the centre of North Head and depressions in the sites topography combined with the landscape's hydrological systems created hanging swamps. This hydrology was altered for the construction and operation of the quarantine facility with water that fell within the catchment redirected to two reservoirs. From the 1930s, many of the military buildings and installations were located within the catchment and the earthworks that were required to develop adversely affected the hydrological systems of the landscape (Cox Architecture, 2024).

3.3.4.2 Stormwater

Current day, stormwater is conveyed through the subject site through concrete pipe drains and concrete side entry pits, which were constructed across the site, during different periods. Larger streets have sub surface concrete storm water drains and pit systems (Mawland Construction Pty Ltd. 2008, Thompson Berrill Landscape Design Pty Ltd, 2006)

The current condition of stormwater control mechanisms varies in quality and state of repair. Extensive work was carried out to divert storm water from entering the sewer system which was an on-going problem due to original poor design. Most down pipes and open culverts are now diverted away from the sewer drains. All stormwater that isn't absorbed by the ground drains to QS Beach enters Sydney Harbour from a 600mm diameter concrete pipe located above the high tide mark at the south end of the beach (Mawland Construction Pty Ltd. 2008).

Areas of surface erosion lacking formalised stormwater measures as identified in the Heritage Landscape Management Plan for Q Station (Thompson Berrill Landscape Design Pty Ltd, 2006) have been progressively stabilised.

As shown in Figure 3-4 a large proportion of stormwater runoff is generated upslope and beyond the subject site boundary and Q Stations' operational control. Except for the North Head Scenic Drive, the external catchment area comprises bushland.



Figure 3-4. Subject site catchment and stormwater runoff (source: Manidis Roberts, 2001)

3.3.5 Fire History

Heath and scrub vegetation has evolved with fire over many thousands of years to the extent that they require fire to trigger reproduction. For many of the native plants, fire stimulates flowering and seed dispersal, germination of the soil stored seed bank, or regrowth from epicormic buds and lignotubers (depending on the species and its tolerance to fire).

The absence of fire for the last 30 years has favoured dominance of senescent *Leptospermum laevigatum* (tea tree scrub) whose tall thick canopy suppresses regeneration of the diverse range of groundcover and shrub species (Cox Architects, February 2024).

This is supported by Skelton et al., (2003) who detail the known fire history of North Head and conclude that the past fire frequency was leading to a loss of biodiversity in the heath and coastal scrub communities with local extinctions of species likely to be occurring. This evidenced by much of the heath, scrub, woodland and forest communities becoming dominated by species that are favoured by an absence of fire, such as: *Pittosporum undulatum*, *Melaleuca armillaris*, *Leptospermum laevigatum*, and the exotic and native weeds *Cinnamomum camphora* and *Tristania confertus* (synonym for *Lophostemon confertus*) respectively.

The Fire Management Plan for Sydney Harbour & Botany Bay (La Perouse Precinct) National Parks (DEC, 2004) has mapped the Bushfire Potential Behaviour for the site, which is summarised as follows:

- + High Bushfire Behaviour Potential areas include:
 - Coastal Heathland to the south western portion of the site (i.e. behind Isolation);
 - the Heathland immediately east of Third-Class Precinct and north of Second Cemetery;
 - the Coastal Woodland escarpment between Wharf Precinct and First and Second Class, and
 - a small path of overstorey vegetation on the escarpment in front of Isolation.
- + Moderate Bushfire Behaviour Potential areas include:
 - Coastal Heathland immediately to the south and east of Third-Class Precinct (with an area of low potential in the vicinity of The Old Mans Hat walking track);
 - the ESBS vegetation to the east of the entire site;
 - the woodland to the northern side of Quarantine Station Entry Road;
 - the Broad-leaved Paperbark gully land associated woodland on the northern boundary of Second Class and Administration; and
 - the escarpment vegetation in front of Isolation extending around to Third Class.

The mown grass areas within the Quarantine Station are identified as having negligible fire risk potential.

NPWS are responsible for implementing the Fire Management Plan for Sydney Harbour & Botany Bay (La Perouse Precinct) National Parks (DEC, 2004) and vegetation management in the site will be consistent with this.

Figure 3 5 shows areas following a prescribed burn on aerial imagery from 26 September 2020 and Figure 3-6 shows the combination of the prescribed September burn and a prescribed burn on 17 October 2020 that broke through containment lines (driven by stronger and earlier winds than forecasted).



Figure 3-5. Evidence of pre-October 2020 hazard burn

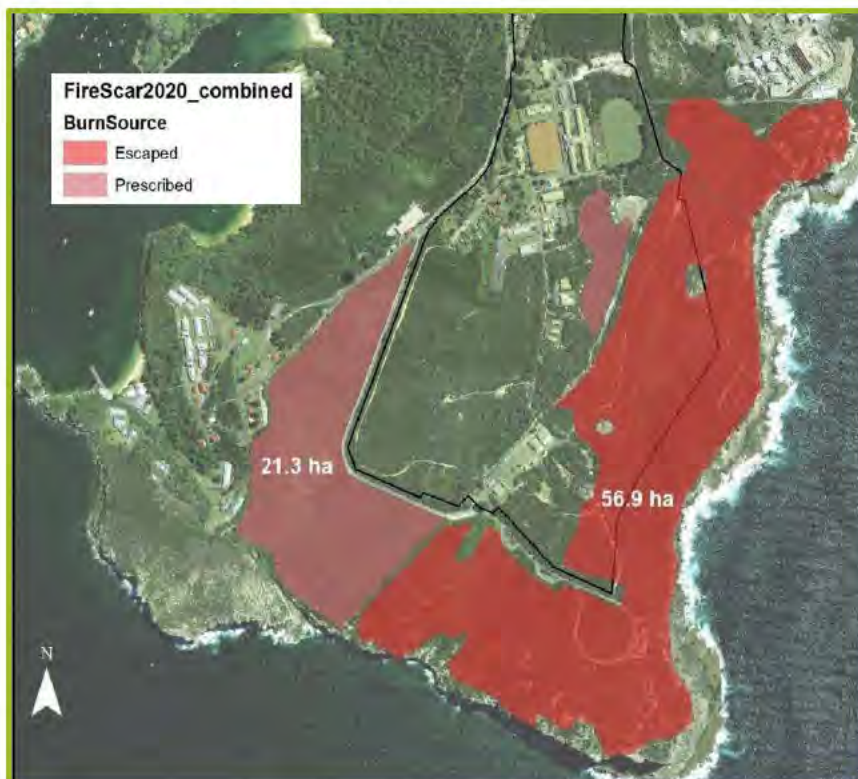


Figure 3-6. Mapped hazard burns (source: AWC 2020 Ecohealth Report)

3.4 Vegetation

3.4.1 Overview

The headland's naturally isolated remnant bushland has been conserved largely by virtue of its historical land uses and soil landscapes. As identified in Section 3.3.3, most soil types have a low to poor capacity for urban development. The types of land uses that transpired historically (the Quarantine Station, defence site, military training base, nature reserve and National Park have supported the retention of extensive tracts of remnant native vegetation.

The native vegetation communities at North Head have been described by a substantial amount of literature. Gunninah (2001) and Skelton et al., (2003) describe over 35 studies relating to North Head and adjacent areas that provide data from 1980 through to 2003.

Limited data and reporting have been produced since this time². An ecological management review and ecological constraints assessment were undertaken for the development of the North Head Sanctuary Master Plan by Eco Logical Australia (2023) and Narla Environmental (2023) respectively. These reports have not been reviewed at the time of writing this report (and it is unclear whether any new and quantitative data was collected).

3.4.2 Vegetation mapping

Most recent vegetation mapping has been reviewed from the following sources:

- + Native Vegetation of the Sydney Metropolitan Area - Version 3_1 VIS_ID 4489 (OEH, 2016)
- + NSW State Vegetation Type Map SVTM_NSW_Extant_PCT_vC2_0_M2_0 (DPE, 2023).

All mapping sources generally concur on the plant community types (PCTs) present within the subject site although the extent and distribution of PCTs vary between each source.

This can be attributed in part to a systematic ecological review of the (Eastern NSW PCT Classification version 1.1), which decommissioned PCTs shown in OEH 2016 mapping and replaced with new PCTs shown in DPE 2022 mapping. For example:

- + Former PCT 664 Coastal Sand Mantle Heath is largely split into two new PCTs, 3805 Southern Sandplain Heath and 3806 Sydney Coastal Sand Mantle Heath
- + Former 1823 Coastal Headland Cliff Line Scrub is largely split into two new PCTs, 3811 Sydney Coastal Headland Cliff Scrub and 3812 Sydney Coastal Sandstone Headland Heath.
- + Former 1822 Coastal Headland Banksia Heath - the relationship between the legacy PCT and new PCTs is weak. The strongest association is to 3812 Sydney Coastal Sandstone Headland Heath but accounts for less than 40% of legacy member plots, with residual plots to other new PCTs including 3806 Sydney Coastal Sand Mantle Heath, 3814 Woronora Plateau Heath-Mallee and 3807 Northern Sydney Heath-Mallee.

DPE 2023 mapping indicates eight (8) PCTs are located within the subject site (see Table 3-3).

Figure 3-7 and Figure 3-8 show OEH 2016 and DPE 2022 mapping within the subject site and surrounding study area.

Table 3-3. Plant community types (PCTs) within the subject site

PCT ID	PCT name	Status	
		BC Act	EPBC Act
3040	Sydney Coastal Foreshores Gully Rainforest	Not listed	CE
3546	Coastal Sands Littoral Scrub-Forest	E	CE
3594	Sydney Coastal Sandstone Foreshores Forest	Not listed	Not listed
3805	Southern Sandplain Heath	CE	CE
3806	Sydney Coastal Sand Mantle Heath	CE	CE
3811	Sydney Coastal Headland Cliff Scrub	Not listed	Not listed
3812	Sydney Coastal Sandstone Headland Heath	Not listed	Not listed
3922	Sydney Coastal Sand Swamp Scrub	E	Not listed

Key E = Endangered CE = Critically Endangered

Field validation of available vegetation mapping was beyond the scope of this assessment. The proposal does not involve any clearing of native vegetation or changed uses that would result in indirect impacts not already considered in existing approval conditions.

Desktop aerial photographic interpretation using 2024 high resolution aerial photography has identified that the boundaries of mapped PCTs do not necessarily align with the current extent of native vegetation in the subject site.

Diagrams illustrating the extent of native vegetation within the subject site used in various reports reviewed for this assessment also varied considerably. However, this might be due to changes in growth / habit of vegetation over time. As indicated by Skelton et al., (2003) and Cox Architects (2024) the absence of fire over time has promoted the growth of a taller and thicker canopy compared to a more diverse range of shrub and groundcover species.

On-site validation of mapped PCT boundaries and verification of DPE (2023) PCT allocations would be beneficial in terms of filling knowledge gaps and guiding ongoing management of remnant vegetation, threatened species habitat and ecological / hazard reduction fire regimes.

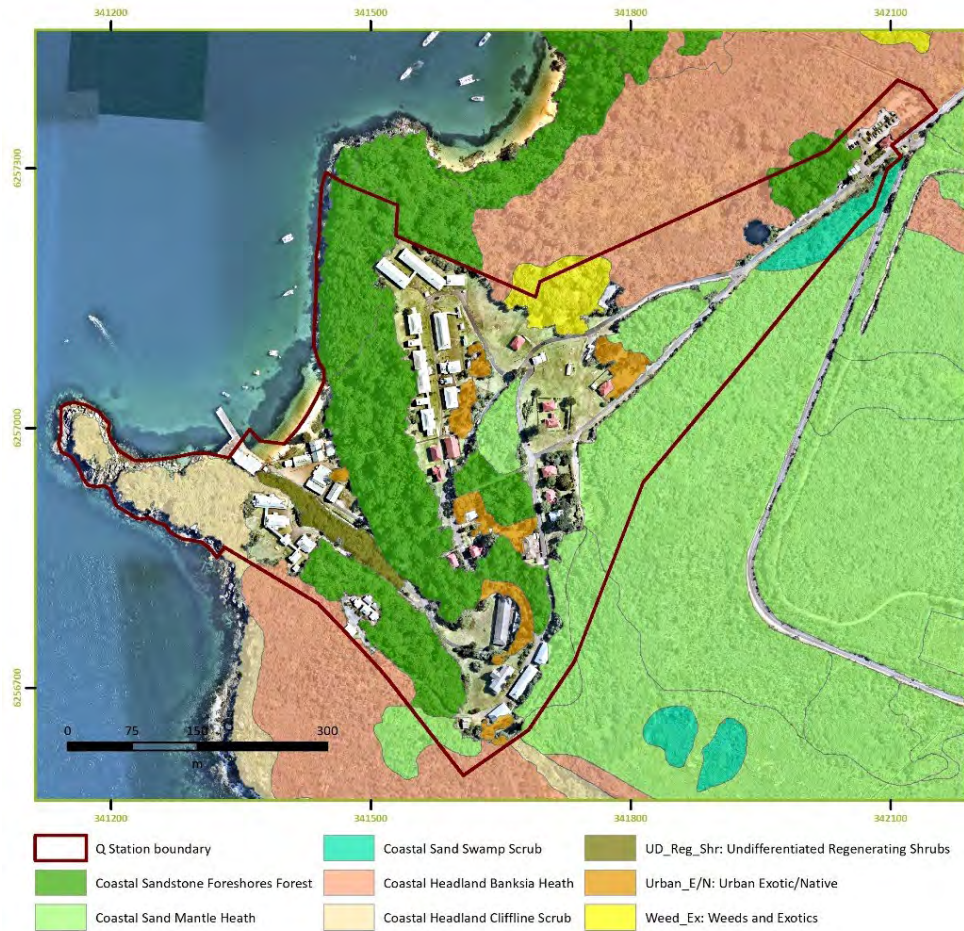


Figure 3-7. Sydney Metropolitan Area (OEH 2016) mapped PCTs

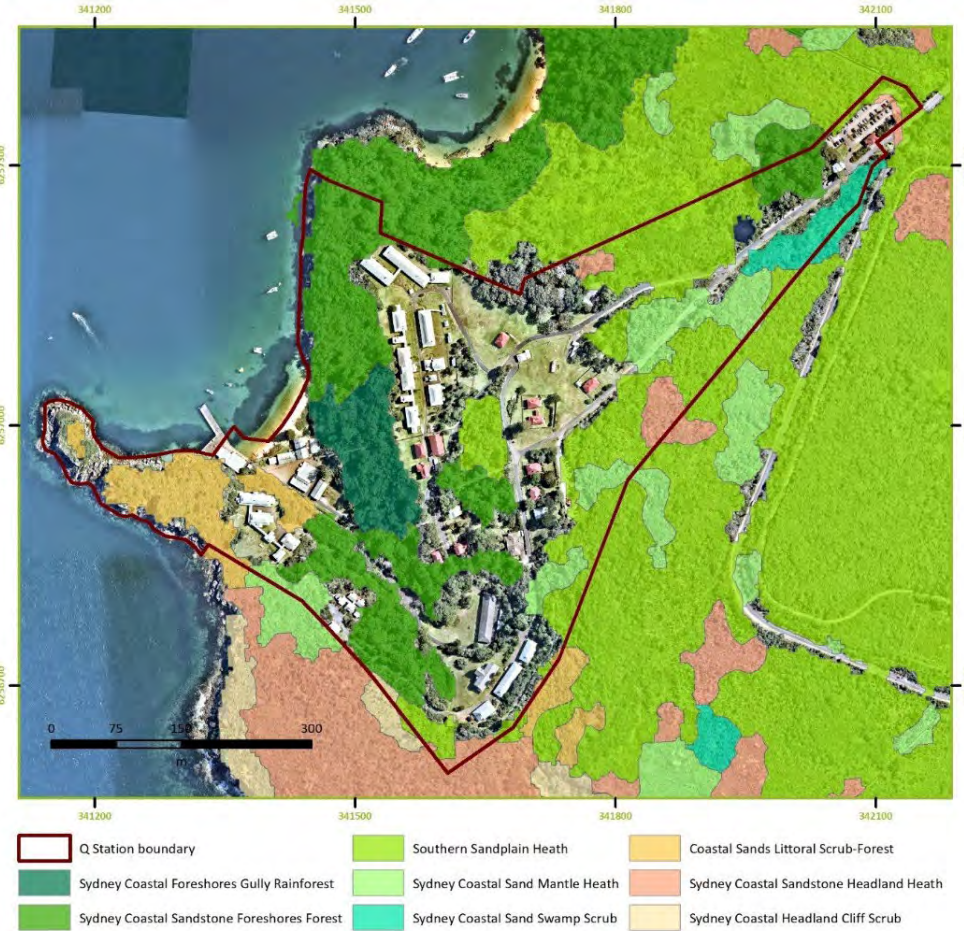


Figure 3-8. SVTM (DPE 2022) mapped PCTs

Threatened species, populations and communities



4. Threatened ecological communities

4.1 Overview

As summarised in Table 3-3 (refer Section 3.4.2) and illustrated in Figure 4-1, five (5) PCTs mapped within the subject site are related to threatened ecological communities (TECs) listed under the NSW BC Act and/or the Commonwealth EPBC Act.

Table 4-1. Threatened ecological communities (TECs) within the subject site

PCT name (PCT ID)	Status
Sydney Coastal Foreshores Gully Rainforest (PCT 3040)	Relates to the Commonwealth Littoral Rainforest and Coastal Vine Thickets of Eastern Australia TEC where it occurs within 2 km of coastline or on an offshore island or adjacent to a large body of saltwater subject to maritime influence and satisfies condition thresholds as per Section 4 of the Listing Advice.
Coastal Sands Littoral Scrub-Forest (PCT 3546)	PCT 3546 relates to the following: <ul style="list-style-type: none"> + NSW Bangalay Sand Forest TEC when it occurs on marine sand as per paragraph 2 of the Final Determination and within the Sydney Basin or South East Corner bioregions (IBRA Version 4.0) as per paragraph 1. + Commonwealth Littoral Rainforest and Coastal Vine Thickets of Eastern Australia TEC where it occurs within 2 km of coastline or on an offshore island or adjacent to a large body of saltwater subject to maritime influence and satisfies condition thresholds as per Section 4 of the Listing Advice.
Southern Sandplain Heath (PCT 3805)	Both PCT 3805 and 3806 relates to the following: <ul style="list-style-type: none"> + NSW Eastern Suburbs Banksia Scrub TEC. + Commonwealth Eastern Suburbs Banksia Scrub TEC where it occurs in Sydney Basin Bioregion between the Hawkesbury River and Stanwell Park as per Section 2.1 of the Conservation Advice. It must also satisfy the minimum condition thresholds set out in Section 2.3 of the Advice, relating to patch size and numbers of native species.
Sydney Coastal Sand Mantle Heath (PCT 3806)	
Sydney Coastal Sand Swamp Scrub (PCT 3922)	Relates to the NSW Sydney Freshwater Wetlands TEC.



Figure 4-1. Indicative TECs in the subject site

4.2 Commonwealth Littoral Rainforest and Coastal Vine Thickets

The NSW Bionet Vegetation Classification database indicates that both Sydney Coastal Foreshores Gully Rainforest (PCT 3040) and Coastal Sands Littoral Scrub-Forest (PCT 3546) are related to the Commonwealth EPBC Act listed Littoral Rainforest and Coastal Vine Thickets TEC.

4.2.1 General description

The Conservation Advice approved by the Delegate of the Minister on 12 November 2015 describes the community as follows:

The Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community is a complex of rainforest and coastal vine thickets on the east coast of Australia influenced by its proximity to the sea. The canopy, which protects less tolerant species and propagules in the understorey from salt laden winds, can range from patchy to closed and may include emergents as well as dead trees due to ongoing natural disturbance.

The vegetation height depends on the degree of exposure and can range from dwarf to medium (<1-25 m; Specht 1970) and tends to merge in a height continuum due to coastal processes.

Plant diversity declines from a north to south direction with the species composition also differing with latitude subject to substrate and nutrient inflow.

4.2.2 Distribution

The Q Station is not located at the limits of the community's known distribution, which is within 2 km of the eastern coastline of Australia, including offshore islands, from Princess Charlotte Bay, Cape York Peninsula to the Gippsland Lakes in Victoria.

It is known to occur in Queensland, New South Wales and Victoria where the relevant Natural Resource Management regions are: Cape York, Wet Tropics, Mackay-Whitsunday, Fitzroy, Burnett-Mary and South East (Queensland); Northern Rivers, Hunter-Central Rivers, Hawkesbury-Nepean, Sydney Metro, Southern Rivers (New South Wales); and East Gippsland (Victoria).

4.2.3 Conservation status

The Littoral Rainforest and Coastal Vine Thickets ecological community is listed as critically endangered under the EPBC Act.

In NSW, the community Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is listed as endangered under the BC Act, but PCT 3040 and PCT 3546 are not associated with this TEC in the TBDC.

Littoral rainforest is the least extensive of the rainforest types in NSW and represents less than one per cent of the total area of rainforest (DEWHA 2015). Estimates for NSW are approximate as they derive from several sources. In 2015, DEWHA reported the total area of occupancy in NSW at approximately 1,624 ha with a total of 433 patches constituting the area of occupancy with patch sizes ranging from 0.06 ha to 136 ha. More specifically:

- + most individual patches, i.e. 92%, are less than 10 ha in size; and
- + only one patch (approximately 0.2%) is greater than 100 ha.

Data used to determine occupancy in NSW is not accurate due to incomplete mapping (i.e., mapping data have not been revised since the SEPP 26 gazettal in 1988) and a slight overestimate where data overlap between Tuross Head and Murramarang National Park (by approximately 30 km) (DEWHA 2015).

Knowledge on the distribution and condition of the ecological community are to be improved under the National Recovery Plan for the ecological community are that by 2029. This is to include:

- + fine scale mapping across the extent of the ecological community,
- + to establish distribution at local and regional management scales; and
- + establishing baseline conditions at local and regional scales and compare these against the condition thresholds (Department of the Environment and Energy, 2019).

To be considered the Commonwealth EPBC Act listed Littoral Rainforest and Coastal Vine Thickets TEC the communities must satisfy condition thresholds as per Section 4 of the Listing Advice.

The EPBC Act listed Littoral Rainforest and Coastal Vine Thickets of Eastern Australia TEC comprises those patches that meet the following key diagnostic characteristics and the condition thresholds presented in Table 4-2.

The condition criteria outlined in Table 4-2 represent the minimum level for patches to be included in the listed ecological community.

Table 4-2. Littoral Rainforest & Coastal Vine Thickets of Eastern Australia - key diagnostic characteristics & condition thresholds

Diagnostic & condition threshold	Relevance
Key diagnostic characteristics	
The ecological community occurs in the following IBRA bioregions: Cape York Peninsula, Wet Tropics, Central Mackay Coast, South Eastern Queensland, NSW North Coast, Sydney Basin and South East Corner.	Meets threshold: occurs in the Sydney Basin
Patches of the ecological community occur within two kilometres of the east coast, including offshore islands, or adjacent to a large body of salt water, such as an estuary, where they are subject to maritime influence.	Meets threshold: the subject site occurs within two kilometres of the east coast and adjacent to a large body of salt water subject to maritime influence.
The structure of the ecological community typically is a closed canopy of trees that can be interspersed with canopy gaps that are common in exposed situations or with storm events.	Not verified[#]: PCT 3040 is described as a mid-high to tall, closed rainforest with occasional sclerophyll emergents, or a tall to very tall sclerophyll open forest with a mid-high sub-canopy of mesophyllous small trees and shrubs. Considered unlikely to meet threshold: PCT 3546 within the subject site does not exist as a canopy of trees and is not considered further.
Usually, several vegetation strata are present. However, where there is extreme exposure to salt laden winds, these strata may merge into a height continuum rather than occurring as distinct vegetation layers. The canopy forms a mosaic due to canopy regeneration, typically in the form of basal coppice following canopy decapitation due to prevailing salt laden winds and storm events. Wind sheared canopy can be present on the frontal section leading to closed secondary canopies. Emergents may be present, for example, species from the genera <i>Araucaria</i> (northern bioregions only), <i>Banksia</i> or <i>Eucalyptus</i> . The ground stratum of the vegetation typically is very sparse.	Not verified or applicable: Several vegetation strata are present. The community is relatively protected from extreme exposure to salt laden winds and canopy regeneration following canopy decapitation is not evident. Emergents of <i>Banksia</i> and <i>Eucalyptus</i> genera are present. PCT 3040 is reported as common on slopes above harbour foreshores with the proximity to maritime influences leading to some floristic characteristics shared with rainforests within the littoral zone elsewhere in the Sydney region.
Condition thresholds	
Small patches can be resilient and viable, but the minimum size of a patch needs to be 0.1 ha	Meets threshold: patch greater than 0.1 ha, i.e. PCT 3040 in the subject site (ignoring other adjacent vegetation patches) has a patch size of approximately 1.8 ha.
The cover of transformer weed species (as identified in Attachment A) is 70% or less	Meets threshold: identified transformer weeds for this TEC are listed below and all are known to occur in

Diagnostic & condition threshold	Relevance
<p>Transformer weeds are highly invasive taxa with the potential to seriously alter the structure and function of the ecological community. This threshold recognises the relative resilience and recoverability of the ecological community to invasion by weed species</p>	<p>the study area. The cover of transformer weeds, while not verified, is anticipated to be 70% or less.</p> <ul style="list-style-type: none"> + <i>Asparagus aethiopicus</i> + <i>Chrysanthemoides monilifera</i> + <i>Delairea odorata</i> + <i>Ehrharta erecta</i> + <i>Lantana camara</i> + <i>Senna pendula</i> + <i>Tradescantia albiflora</i>
<p>The patch must have:</p> <ul style="list-style-type: none"> + at least 25% of the native plant species diversity characteristic of this ecological community in that bioregion (Attachment A); OR + at least 30% canopy cover of one rainforest canopy (either tree or shrub) species (Attachment A, excluding Banksia and Eucalyptus species that may be part of the ecological community). 	<p>Not verified: Species in Attachment A excluding Banksia and Eucalyptus species include:</p> <p>Trees</p> <ul style="list-style-type: none"> + <i>Acmena smithii</i> + <i>Acronychia oblongifolia</i> + <i>Cupaniopsis anacardioides</i> + <i>Diospyros pentamera</i> + <i>Elaeodendron australe</i> + <i>Glochidion ferdinandi</i> + <i>Guioa semiglauca</i> + <i>Livistona australis</i> + <i>Pittosporum undulatum</i> + <i>Podocarpus elatus</i> + <i>Myrsine howittiana</i> + <i>Sarcomelicope simplicifolia</i> + <i>Synoum glandulosum</i> <p>Shrubs</p> <ul style="list-style-type: none"> + <i>Breynia oblongifolia</i> + <i>Notelaea longifolia</i> + <i>Pittosporum revolutum</i> + <i>Syzygium paniculatum</i>[#]

[#]When assessing the likelihood of *Syzygium paniculatum* for the major project SIS, Gunninah (2001) reported that there is no littoral and subtropical rainforest habitat on North Head (which is habitat for *S. paniculatum*).

4.2.4 Threats

The ecological community has been significantly reduced and fragmented by sandmining, agriculture and coastal development (DEWHA 2008, 2009, 2015).

Littoral Rainforest was listed as Critically Endangered because its geographic distribution is severely fragmented and primarily consists of numerous small and disjunct patches, there are demonstrable threats impacting upon it and there have been very severe reductions in the integrity of the ecological community. The key historic and ongoing threat to Littoral Rainforest is coastal development and, given

its distribution, Littoral Rainforest is also highly susceptible to the interacting effects of climate change and sea level rise, both of which exacerbate the existing threats of habitat fragmentation and invasion by transformer weeds (Department of the Environment and Energy, 2019).

Presently, the main key threats to the ecological community and their relevance to the facility’s operation are outlined below:

Habitat loss, degradation and fragmentation as a result of coastal residential development, associated edge effects and infrastructure	Associated edge effects present
Weed infestations	Weed infestations (including transformer weeds) present
Visitor disturbance	Access is managed where PCT 3040 occurs.
Fire	Fire regimes are managed by NPWS
Degradation by overgrazing and trampling by introduced herbivores	Threat not present
Myrtle rust	Potential to occur
Natural disturbances, such as storms and cyclones	Potential to occur

4.2.5 Impact assessment

The mapped PCT 3040 in the QS lease area is located to the north and south of the funicular stairway leading down to the Wharf Precinct from the First-Class Precinct (see Figure 4-1).

The continued operation of Q Station does not involve vegetation clearing, however weed infestations (including transformer weed species) present along the exposed edges of the community should be managed to ensure native diversity.

It is further recommended that this PCT’s extent, native and weed species composition are verified to ensure that the legal status and condition of this vegetation is understood, and Q Station’s Information Management System updated accordingly.

4.3 Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions

4.3.1 General description

Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions (Bangalay Sand Forest) typically has a dense to open tree canopy, approximately 5-20 m tall, depending on exposure and disturbance history. The most common tree species include Bangalay (*Eucalyptus botryoides*) and Coast Banksia (*Banksia integrifolia* subsp. *integrifolia*), while Blackbutt (*Eucalyptus pilularis*) and Lilly Pilly (*Acmena smithii*) may occur in more sheltered situations, and Swamp Oak (*Casuarina glauca*) may occur on dunes exposed to salt-bearing sea breezes.

The open shrub stratum may be dominated by sclerophyllous species, such as Old Man Banksia (*Banksia serrata*), Coast Teatree (*Leptospermum laevigatum*) and Tree Broom-heath (*Monotoca elliptica*), or mesophyllous, species, such as Coffee Bush (*Breynia oblongifolia*) and Sweet Pittosporum (*Pittosporum undulatum*), or a combination of both. Shrubs may vary in height from one to ten metres tall. The groundcover varies from open to dense and may be sparse where the tree canopy is dense or where there is a thick litter of leaves and branches.

4.3.2 Distribution

The Q Station is not located at the limits of the community’s known distribution, which extends from the Bega Valley LGA in the south and is found further north of Q Station.

The Northern Beaches Council report that, on the Northern Beaches, Bangalay Sand Forest occurs in Dee Why Lagoon Wildlife Refuge and Irrawong Reserve.

SVTM identifies PCTs that relate to the threatened ecological community (PCTs 3546, 3638, 3639, 3640) occurring in northern NSW.

4.3.3 Conservation status

Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions was first gazetted as an Endangered Ecological Community on 21 October 2005 and the NSW Scientific Committee final determination later amended in 2011.

Areas of Bangalay Sand Forest are conserved within National Parks, including Royal, Seven Mile Beach, Conjola, Meroo, Murramarang, Eurobodalla and Biamanga National Parks. Additions to the coastal reserve system and land use zoning have protected some stands of Bangalay Sand Forest from clearing (NSW Scientific Committee 2011).

The Bangalay Sand Forest ecological community was not prioritised for assessment by the Commonwealth government as it was considered unlikely to meet national listing thresholds that would confer full protection under the EPBC Act (DCCEEW 2024).

4.3.4 Threats

Threats identified in the TBDC and relevance to the facility’s operation are outlined as follows:

Habitat loss, degradation and fragmentation as a result of coastal residential development, associated edge effects and infrastructure	Associated edge effects present
Weed infestations	Weed infestations (including transformer weeds) present
Habitat loss, degradation and fragmentation as a result of recreational activities (e.g. beach access trails and campsites)	Access trails are not located where this community occurs.
Bell Miner associated dieback	Threat not present
Inappropriate fire regime	Fire regimes are managed by NPWS
Degradation by overgrazing and trampling by introduced herbivores	Threat not present
Myrtle rust	Potential to occur

4.3.5 Impact assessment

Mapped PCT 3546 within the QS lease area is located on the exposed western harbour side overlying the Lambert soil landscape (which comprise shallow, poorly drained soils) (see Figure 4-1). PCT 3546 at this location appears to comprise a heath or open scrub community within occasional trees and lacks a dense or open tree canopy as described in its listing.

Consequently, it is considered unlikely that PCT 3546 within the QS lease area is commensurate with the NSW listed TEC.

The continued operation of Q Station does not involve vegetation clearing, however weed infestations (including transformer weed species) present along the exposed edges of the community should be managed to ensure native diversity.

It is further recommended that this PCT's extent, native and weed species composition are verified to ensure that the legal status and condition of this vegetation is understood, and Q Station's Information Management System updated accordingly.

4.4 Eastern Suburbs Banksia Scrub

4.4.1 General description

Eastern Suburbs Banksia Scrub (ESBS) is a sclerophyllous heath/scrub community that occurs on disjunct patches of nutrient poor, aeolian dune sand and may contain small patches of woodland, low forest or limited wetter areas, depending on site topography and hydrology.

The range of species present varies, but the shrub layer frequently includes Banksia species such as *Banksia aemula* (Wallum Banksia) and *Banksia serrata* (Old Man Banksia, Sawleafed Banksia, Wiryagan) as well as other characteristic woody species such as *Monotoca elliptica* (Tree Broom-heath), *Acacia suaveolens* (Sweet Wattle), *Allocasuarina distyla* (Scrub Sheoak), *Isopogon anemonifolius* (Broad-leaf Drumsticks), *Kunzea ambigua* (Tick Bush), *Ricinocarpus pinifolius* (Wedding Bush) and *Leptospermum laevigatum* (Coast Tea Tree). A wide range of other woody species may also be present, including *Banksia ericifolia* subsp. *ericifolia* (Heath-leaved Banksia), which may become locally abundant in damp sites and where soils transition from deep Quaternary sands to shallower yellow earths derived from sandstone. The ground layer also varies but frequently contains a range of sedges, graminoids and forbs (Commonwealth of Australia 2021).

The species composition of a site will be influenced by the size of the site and by its recent disturbance history. For a number of years after a major disturbance dominance by a few species (such as *Kunzea ambigua* or *Leptospermum laevigatum*) may occur, with gradual restoration of a more complex floristic composition and vegetation structure over time. The balance between species will change with time since fire and may also change in response to changes in fire regimes (Commonwealth of Australia 2021).

ESBS has been reported from areas of sand deposits in the local government areas of Botany, Manly, Randwick, Waverley and Woollahra which are all within the Sydney Basin Bioregion. On North Head, the ecological community occurs on a sand sheet of similar age and composition to that on which the ecological community occurs further south NSW Scientific Committee, 2017).

4.4.2 Distribution

The distribution of ESBS is very highly restricted. The extent of occurrence of ESBS is 156 km² based on a minimum convex polygon enclosing all occurrences of the community mapped by Tozer et al., 2010 and OEH, 2013b and the method of assessment recommended by IUCN, Bland et al. 2017 (in NSW Scientific Committee 2017). Some 65 km² of this area comprises coastal open waters. The estimated area of occupancy (AOO) of ESBS is 400 km² based on occupancy of cells in a 10 x 10 km grid, the scale recommended for assessing AOO by the IUCN (NSW Scientific Committee 2017).

Remnants of ESBS are known from North Head, which is one of the largest remnants; in eastern Sydney, where numerous small remnants occur on various tenures but primarily within public parks such as Malabar Head National Park and Randwick Environment Park, as well as on various golf courses; and in south eastern Sydney where there are remnants occurring on dunes at Kamay Botany Bay National Park (both at La Perouse and Kurnell Peninsula) and in Royal National Park, predominantly near Bundeena (Commonwealth of Australia, 2021).

The Q Station is not located at the limits of the community's known distribution, which extends from the Hawkesbury River in the north and Stanwell Park at the southernmost extent of Royal National Park in the south (Commonwealth of Australia, 2021).

4.4.3 Conservation status

ESBS is listed as critically endangered on Schedule 1 Part 3 of the BC Act and as critically endangered under the EPBC Act. The community once occupied approximately 5,300 hectares between North Head and Botany Bay in the Sydney Basin Bioregion (DEC 2004).

Less than 3% (146 ha) of the original distribution of ESBS (5,300 ha) remains, in a few small and isolated remnants. Only 33 hectares of ESBS (or 0.6% of its original distribution) occurs within conservation reserves (Kamay Botany Bay National Park, Royal National Park and Sydney Harbour National Park). In 1997, the NSW Scientific Committee listed ESBS as an endangered ecological community on Schedule 1 Part 3 of the BC Act.

This listing occurred because in view of the substantial reduction in the area occupied by ESBS, its fragmentation and the numerous threats operating on surviving remnants, the NSW Scientific Committee believed the community was likely to become extinct in nature in NSW unless the factors threatening its survival ceased to operate. In 2000, the Commonwealth Threatened Species Scientific Committee listed Eastern Suburbs Banksia Scrub of the Sydney Region as a critically endangered ecological community under the EPBC Act (DEC 2004).

The NSW Bionet Vegetation Classification database indicates that both PCT 3805 and 3806 relate to the NSW and Commonwealth listed Eastern Suburbs Banksia Scrub TEC. There are no thresholds for the NSW listed ESBS. For the community to be considered as the Commonwealth TEC it must satisfy the minimum condition thresholds set out in Section 2.3 of the Commonwealth Advice, relating to patch size and numbers of native species (see Table 4-3).

Table 4-3. Eastern Suburbs Banksia Scrub - key diagnostic characteristics & condition thresholds

Diagnostic & condition threshold	Relevance
Key diagnostic characteristics	
Occurs in Sydney Basin Bioregion within 10 km of the coast, between the Hawkesbury River estuary in the north and Stanwell Park in the south. Within this area, the ecological community typically occurs on headlands, sandplains or dunes near the coast, but not on dunes comprised primarily of sand of recent marine origin.	Meets threshold: occurs in the Sydney Basin within an appropriate environment.
The ecological community occurs on low nutrient sands, of primarily Quaternary age, and commonly of wind-blown origin. These sands are often podsolised, showing contrasting horizons. These soils are underlain by sandstone. The depth to this sandstone layer varies: small areas of sandstone may outcrop but typically outcrops are.	Meets threshold: occurs on low nutrient sands underlain by sandstone
The structure and floristics of the ecological community vary in response to landscape position, soil depth and drainage as well as disturbance, in particular fire history and soil disturbance. Typically, the ecological community occurs in a predominantly sclerophyllous heath, shrubland or scrub. Some trees and localised wetter patches may be present.	Meets threshold: occurs in a predominantly sclerophyllous heath, shrubland or scrub.
No species are known to be present at all sites but species most commonly associated with the ecological community are shrubs such as: <i>Acacia longifolia</i> , <i>A. suaveolens</i> , <i>Allocasuarina distyla</i> , <i>Banksia aemula</i> , <i>B. serrata</i> , <i>Isopogon anemonifolius</i> , <i>Kunzea ambigua</i> , <i>Lambertia formosa</i> , <i>Leptospermum laevigatum</i> ,	Meets threshold: occurs in a predominantly sclerophyllous heath, shrubland or scrub. The listed most commonly associated species are

Diagnostic & condition threshold	Relevance
<i>Leucopogon ericoides</i> , <i>Melaleuca nodosa</i> , <i>Monotoca elliptica</i> , <i>Persoonia lanceolata</i> , <i>Philothea salsolifolia</i> , <i>Pimelea linifolia</i> , <i>Ricinocarpos pinifolius</i> , <i>Styphelia viridis</i> , <i>Woollsia pungens</i> and a range of native peas.	reported from the subject site PCTs and surrounding study area.
Condition thresholds	
Minimum patch size 0.05 ha AND	Meets threshold: occurs in patches greater than 0.05 ha.
No more than 70% perennial weed cover (mean cover estimated across strata present e.g. ground layer, shrub layer)	Meets threshold: no more than 70% perennial weed cover present in patches

4.4.4 Threats

A major threat to ESBS is the further loss and fragmentation of habitat because of clearing and development. Other known threats identified in the ESBS Recovery Plan (DEC 2004) and their relevance to the facility's operation are outlined below:

Weed invasion	Relevant
Inappropriate fire regimes	Fire regimes are managed by NPWS
Mowing, slashing and the inappropriate use of herbicides	QS landscape maintenance consider bushland sensitivity
Grazing by horses and rabbits	Threat not present
Over shading	Threat not present
Infection by <i>Phytophthora cinnamomi</i>	Potential to occur
Erosion and physical damage from surface water run-off	Areas of surface erosion lacking formalised stormwater measures as identified in the Heritage Landscape Management Plan for Q Station (Thompson Berrill Landscape Design Pty Ltd, 2006) have been progressively stabilised.
Altered nutrient flows and hydrological regimes	Current day, stormwater under the control of the facility's operation is conveyed through storm water drains and pit systems and away from bushland.
Bicycles, motor vehicles, horses, rabbits and excessive pedestrian use	Threat not present
Inappropriate plantings	Threat not present
Factors affecting pollination and seed dispersal processes	Threat not present
Seed and wildflower collection	Threat not present
Rubbish dumping of rubbish (including construction materials and green waste)	Threat not present

4.4.5 ESBS Recovery Plan

The recovery plan describes the current understanding of ESBS³ and documents the management actions undertaken to date and outlines a recovery program over the next five years. To provide for the future recovery of ESBS, this plan advocates a recovery program that:

- + Maps, assesses and monitors the condition of all ESBS remnants
- + Ensures that ESBS remnants are not destroyed and that an increased level of legislative protection is provided over land that provides habitat for ESBS
- + Favours *in-situ* protection and the management of threats at ESBS sites
- + Raises public awareness of ESBS and encourages active community participation in its conservation
- + Examines the ecological aspects of ESBS which will inform management decisions regarding the long-term conservation of the community

4.4.6 Impact assessment

The continued operation of Q Station does not involve vegetation clearing, however weed infestations (including transformer weed species) present along the exposed edges of the community should be managed to ensure native diversity. In particular, where the community is exposed along access roads.

As shown in Figure 4-2, mapped PCT 3805 and PCT 3806 extends over 7.03 ha within the QS lease area, which comprises:

- + 6.20 ha of PCT 3805 in 3 x patches (0.13 ha, 0.19 ha and 0.51 ha), and
- + 0.83 ha of PCT 3806 in 8 x patches (0.05 ha, 0.09 ha, 0.11 ha, 0.15 ha, 0.40 ha, 0.45 ha, 0.58 ha and 1.61 ha)

Figure 4-2 also shows ESBS mapping that was produced in 2008 and the locations of two ESBS sites that are being monitored by NPWS. The northern most monitoring site (identified as ESBS site 6) does not appear to be in ESBS. This is supported by SVTM (DPE 2023) mapping and aerial photographic interpretation (API).

DPE (2023) have Sydney Coastal Sandstone Foreshore Forest (PCT 3594) in this location and API indicates woodland or open forest community (vs heathland or shrubland) at this location (although it is noted that the community can contain trees depending on soil depths). The Heritage Landscape Management Plan for Q Station (Thompson Berrill 2006) also identifies this locality as forest.

It is further recommended that this PCT's extent, native and weed species composition are verified and Q Station's Information Management System updated accordingly.

³ As of 2004, when the plan was prepared.

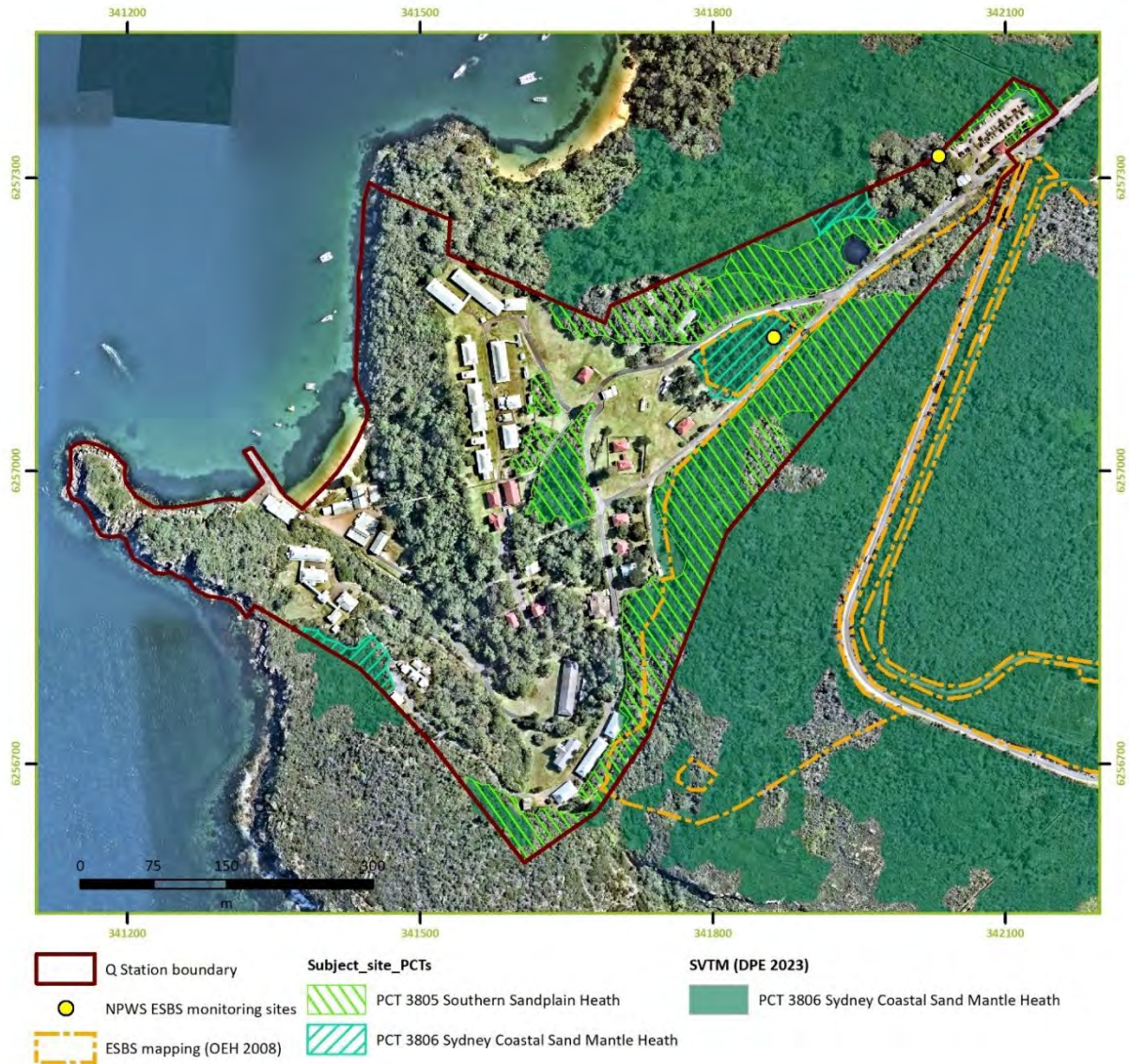


Figure 4-2. ESBS mapping within the QS lease area

4.5 NSW Sydney Freshwater Wetlands

4.5.1 General description

The NSW Bionet Vegetation Classification database indicates that Sydney Coastal Sand Swamp Scrub (PCT 3922) relates to the NSW Sydney Freshwater Wetlands TEC.

Sydney Freshwater Wetlands is described in the TBDC as a complex of vegetation types largely restricted to freshwater swamps in coastal areas. These also vary considerably due to fluctuating water levels and seasonal conditions. Areas of open water may occur where drainage conditions have been altered and there may also be patches of emergent trees and shrubs.

PCT 3922 is described in the Bionet vegetation classification database as a tall to very tall shrubland or open shrubland with a damp ground cover of sedges and ferns and occasional eucalypt emergents restricted to dune swales on coastal sandplains or headland dune systems in the Sydney coastal area.

A low, sparse tree cover of *Eucalyptus robusta* is occasionally recorded with a sparse to mid-dense shrub layer that very frequently includes *Callistemon citrinus* and *Acacia longifolia* and commonly *Banksia robur*, *Banksia ericifolia*, *Banksia integrifolia* and *Monotoca elliptica*. The ground layer consists of a dense cover

of sedges including saw-sedges (*Gahnia clarkei* and *Gahnia sieberiana*), *Machaerina juncea*, *Leptocarpus tenax*, small ferns-mainly *Gleichenia dicarpa*, and grasses including *Imperata cylindrica*.

The final determination to list Sydney Freshwater Wetlands describes the TEC as a mosaic community with considerable variation due to fluctuating water levels and seasonal conditions. Characteristic vegetation is sedges and aquatics particularly *Eleocharis sphacelata*, *Baumea juncea*, *Baumea rubiginosa*, *Baumea articulata*, *Gahnia sieberiana*, *Ludwigia peploides* subsp. *montevidensis* and *Persicaria species*. There may be considerable areas of open water particularly where drainage conditions have been altered. There may be patches of emergent trees such as *Melaleuca quinquenervia* and shrubs (including *Leptospermum juniperinum*, *Banksia robur*, *Callistemon citrinus*, *Melaleuca nodosa*, *Viminaria juncea*).

Within the subject site, mapped PCT 3922 contains species consistent with the TEC including: *Gahnia clarkei* and *Gahnia sieberiana*, *Gleichenia dicarpa*, *Pteridium esculentum*, *Melaleuca nodosa*, *Lomandra longifolia* and *Imperata cylindrica*.

4.5.2 Distribution

The amended final determination (NSW Scientific Committee 2011) characterises the community as restricted to freshwater swamps in swales and depressions on sand dunes and low nutrient sandplain sites in coastal areas.

All sites are located within the Sydney Basin Bioregion occurring between 5-60 metres asl. It has a patchy distribution and occurs in small areas that have been subjected to a long history of disturbance owing to the proximity to urban areas. It is possible that similar communities may also occur in the Illawarra and Central Coast regions.

The Q Station is not located at the limits of the community’s known distribution, which extends from the Wollongong LGA up to the Lake Macquarie LGA, also occurring in the LGAs of Wyong, Gosford, Pittwater, Warringah, Woollahra, Waverley, Botany, Rockdale, Randwick and Sutherland.

4.5.3 Conservation status

Sydney Freshwater Wetlands is listed as endangered under the BC Act but this community does not have an equivalent TEC listed under the Commonwealth EPBC Act.

Sydney Freshwater Wetlands were formerly particularly extensive in the Sydney Eastern Suburbs and Kurnell area. Occurrences have been reported to include Jewells Swamp, Wallarah wetland, Budgewoi wetlands, Porters Creek wetland, Wyong Golf Course, Tuggerah Oxbow, Bateau Bay; Iluka Lagoon; Everglades Lagoon Umina, Deep Creek Warringah, Dee Why Lagoon, Lachlan Swamps, Centennial Park, Botany Swamps at Eastlakes, La Perouse, Kurnell, Potter Point, Bundeena and Marley Lagoons and Coomaditchy Lagoon, but the ecological community may also occur elsewhere. Small areas of Sydney Freshwater Wetlands have been reported to occur in Wyrribalong, Royal and Botany Bay National Parks.

In view of the small size of existing remnants, and the threat of further clearing, disturbance and degradation, the NSW Scientific Committee (2000) is of the opinion that the Sydney Freshwater Wetlands in the Sydney Basin Bioregion are likely to become extinct in nature in NSW unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

4.5.4 Threats

Threats identified in the TBDC and relevance to the facility’s operation are outlined as follows:

Weed infestations	Weed infestations present
Erosion and sedimentation	The areas of mapped as containing this community are subject to stormwater runoff that originates from outside of the QS lease area (i.e., the North Head Scenic Drive)
Altered hydrological regime	
Chemical pollution / eutrophication	

Invasion and establishment of pioneering native species, particularly <i>Typha</i> as well as <i>Casuarina glauca</i> , and <i>Banksia integrifolia</i>	<i>Banksia integrifolia</i> present
Habitat loss, degradation and fragmentation as a result of recreational activities (e.g. beach access trails and campsites)	Access trails are not located where this community occurs.
Inappropriate fire regime	Fire regimes are managed by NPWS
Damage caused by human disturbance: motorbikes, bicycles, 4WD vehicles, arson, rubbish dumping, trampling, erosion	Threat not present - access to facility by public controlled
Lack of knowledge - Insufficient understanding of distribution and/or abundance	Present – information available in writing this report is over 10 yrs old

4.6 Relevant conditions/guidelines

4.6.1 Conditions

Most conditions relevant to vegetation management have generally been fulfilled during the initial construction phase of conservation and adaptive re-use proposal (MP08_0041 conditions 158-160) and are not relevant to operational phase of the MP08_0041 approval.

4.6.2 Guidelines

Ongoing vegetation management guidelines were provided in the Heritage Landscape Management Plan (HLMP) for Q Station (Thompson Berrill 2006). These generally include:

- + All vegetation communities are to be managed in accordance with the Fire Management Plan Sydney Harbour & Botany Bay (La Perouse Precinct) National Parks (DEC, 2004), and the ESBS Recovery Plan.
- + Develop and implement a bushland management program to address weed issues within the lease boundary, consistent with DEC requirements of Fire Management Plan Sydney Harbour & Botany Bay (La Perouse Precinct) National Parks (DEC, 2004).

Specific reference to the Eastern Suburbs Banksia Scrub TEC in the HLMP are provided in Table 4-4 below. Noting that management actions relating to the completed reconstruction or new construction activities cited in the EIS (Manidis Roberts, 2003) are not included.

Table 4-4 Eastern Suburbs Banksia Scrub HLMP guidelines

No.	Vegetation zone	Guidelines /Actions
4.2.3.1e	Third Class Asiatics Precinct ESBS 1	Guideline: ESBS vegetation community is to be managed in accordance with the DEC requirements of Fire Management Plan Sydney Harbour & Botany Bay (La Perouse Precinct) National Parks (DEC, 2004), and the ESBS Recovery Plan.
4.2.3.1f	Administration Precinct ESBS 2	Guideline: ESBS vegetation community is to be managed in accordance with the DEC requirements of Fire Management Plan Sydney Harbour & Botany Bay (La Perouse Precinct) National Parks (DEC, 2004), and the ESBS Recovery Plan.
	ESBS 3	Guideline: ESBS vegetation community is located between the entry and exit roads on the site, and to be managed in accordance with the DEC Recovery Plan and Fire Management Plan for the Quarantine Station. Included in this zone is the one remaining remnant Camfield's Stringybark

No.	Vegetation zone	Guidelines /Actions
		<i>Eucalyptus camfieldii</i> on the site, and Sunshine Wattles <i>Acacia terminalis</i> spp <i>terminalis</i> both of which are threatened species t.
	ESBS 3	Action: Prepare bushland management program for the fork in the road, consistent with the ESBS Recovery Plan (DEC 2004), to allow natural regeneration of ESBS. A minimum of 10 metres back from the fork in the road is to have all weed species and species greater than 0.6m in height selectively removed to retain clear vehicle sightlines.
4.2.5.2a	ESBS regenerative areas	Action: Cease mowing/slashing in the areas shown on Dwg. No. QS-10b to allow ESBS regeneration. Develop a management program for the ongoing management of this vegetation consistent with the Recovery Plan and the future DEC requirements of the Fire Management Plan Sydney Harbour & Botany Bay (La Perouse Precinct) National Parks (DEC 2004).
5.3.3.5c		Action: Mawland to liaise with Heritage Office and DEC to determine an appropriate treatment to, as a minimum, protect the former building foundations south-east of Third Class which are located in an area of ESBS vegetation.

4.6.2.1 ESBS regenerative areas

The ESBS regeneration areas identified in the HLMP are a component of fulfilling Condition 154(h), which required the provision of up to twenty times the amount of ESBS removed as part of the works on the site or alternatively off-site. The works result in an estimated 290m² area of ESBS to be removed, which at twenty times the compensatory habitat required, resulted in a total estimated area of 5,800m².

The ESBS regeneration areas identified in the HLMP covered an estimated area of 3,486m² (with 2,310m² required offsite). Figure 4-3 and Figure 4-4 show extracts Landscape Masterplan drawings QS-10B and QS-10B (respectively) that identify ESBS regeneration areas.



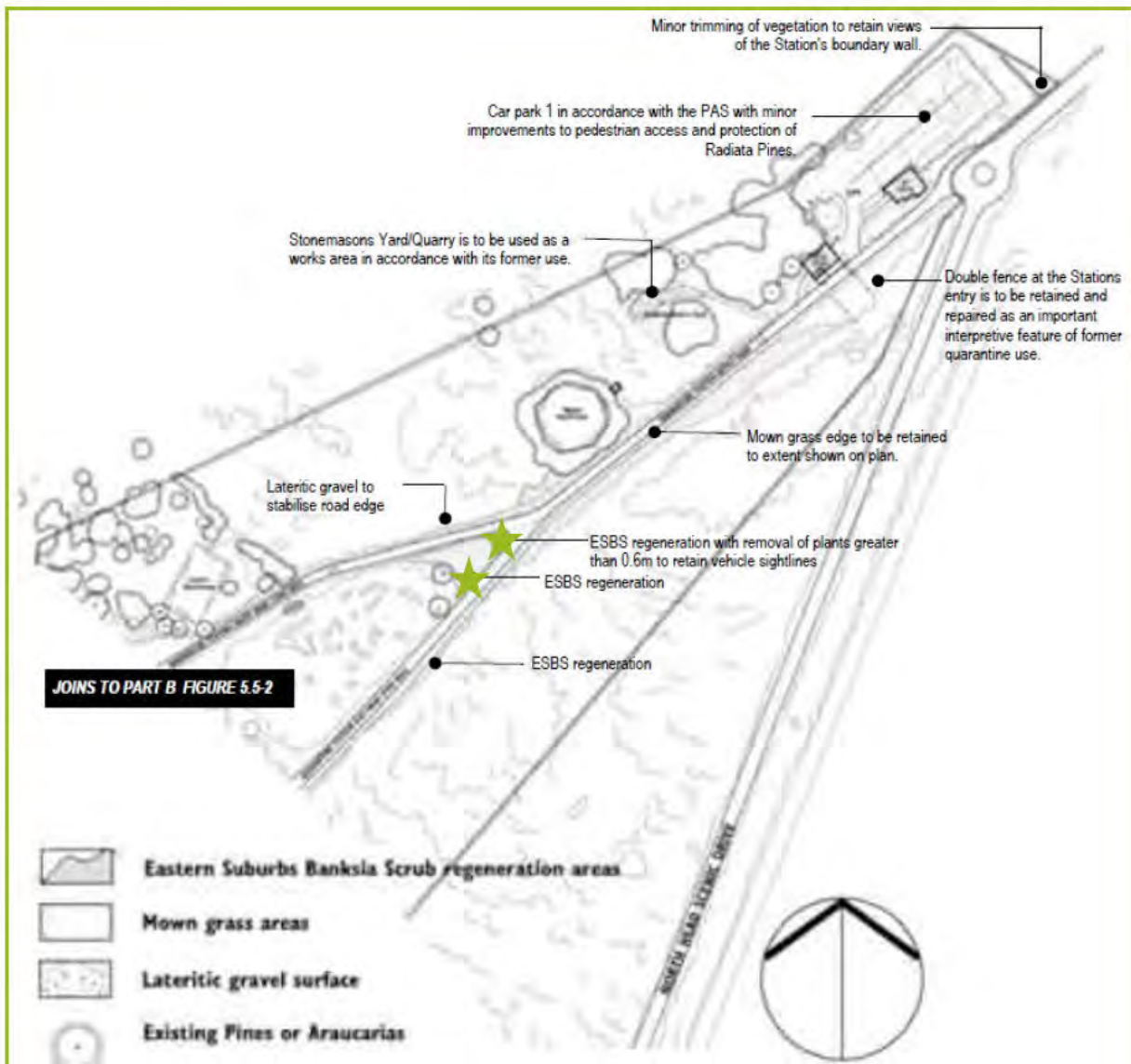


Figure 4-3. Extract from QS Landscape Masterplan QS-10B showing area of ESBS regeneration

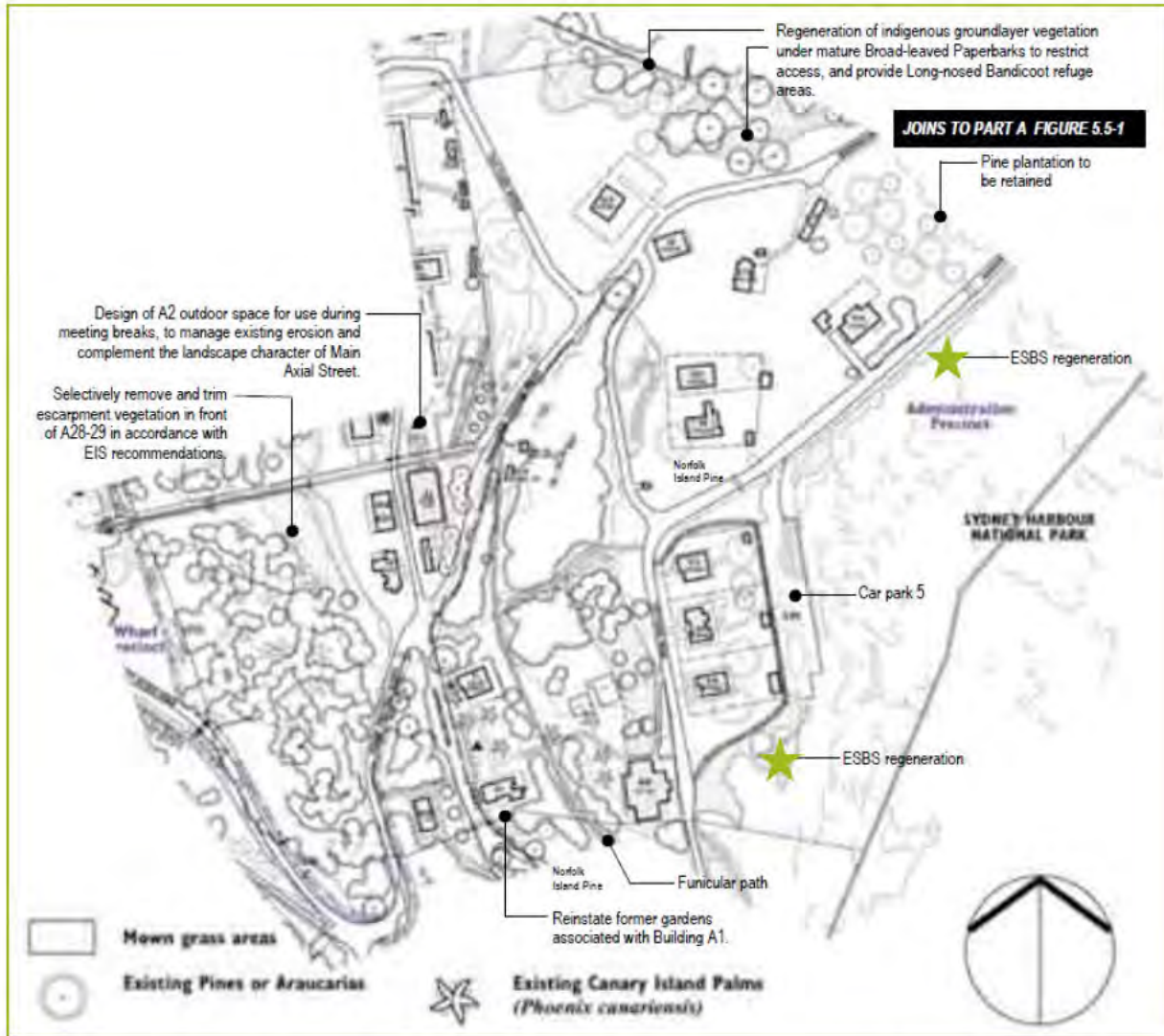


Figure 4-4. Extract from QS Landscape Masterplan QS-10C showing area of ESBS regeneration

4.7 Impact assessment

4.7.1 Direct impacts

The ongoing operation of Q Station is not anticipated to directly impact on any of the TECs mapped within the subject site. No clearing of vegetation is proposed. Potential clearing required for maintenance of Asset Protection Zones (APZs) will be subject to a separate approval process to be led by NPWS.

The risk of the Q Station's continued operation is also not anticipated to indirectly impact on any TECs, above that which already exists. For example:

- + Edge effects such as solar radiation, wind speed, soil and air temperature becoming altered along edges to roads and cleared areas containing buildings etc.
- + Weed infestations also rising as an edge effect, but also from weed dispersal in water, wind and on animals.
- + Inadvertent introduction of disease or pathogens such as *Phytophthora*, which is already known to occur at North Head.

4.7.2 Indirect impacts

The ongoing operation of the facility is not anticipated to exacerbate the key threats identified for each TEC, providing that the ongoing management of the subject site's bushland considers how weed control (including competition by native pioneering species and transformer weed species) and fire management do not result in adverse effects on each TEC.

4.8 Mitigation measures

As recommended for vegetation mapping in Section 3.4.2, on site validation of mapped PCT boundaries and verification of DPE (2023) PCT allocations should be undertaken, and Q Station's Information Management System updated accordingly.

In particular, the extent of TECs within the QS lease area should be validated through ground truthing of species composition and comparison of diagnostic species and condition thresholds.

It is also recommended that the current NPWS monitoring program for ESBS be expanded to include additional ESBS regeneration areas and at least one reference site within the QS lease area (and operational control of NHS) that contains remnant ESBS that is sufficiently buffered from edge effects and anthropogenic activities.

5. Threatened Flora

5.1 *Posidonia australis*

5.1.1 General description

Posidonia australis, also commonly referred to as strapweed, is a type of seagrass that is endemic (native) to the temperate marine and estuarine waters of the southern half of Australia. Meadows of *P. australis* are composed of a rhizome mat, usually buried under the sand or mud, with vertical shoots emerging through the sediment. Each shoot carries 2-4 strap-like leaves, which are often heavily covered with epiphytes. The plant spreads across the surface of the seafloor by extending horizontal shoots into bare areas, which consolidate sediment and become buried. As the rhizome mat spreads, it consolidates and produces a complex arrangement of dense vertical shoots.

The development of large meadows of *P. australis* is thought to have occurred primarily through rhizomatous growth, that is, through the division and spreading of the horizontal shoots. This process is extremely slow (West 1983, Meehan & West 2000), and it has been calculated that the existing extensive meadows of *P. australis* may have taken centuries to establish (Fisheries Scientific Committee, 2010).

5.1.2 *Posidonia australis* in the study area

Table 5-1 summarises the locations of *P. australis* found by Marine Pollution Research Pty Ltd (MPR) during investigations conducted in 2003 (see also Figure 5-1).

Table 5-1. *Posidonia australis* in the MPR study area

Location ID	Depth range	MPR field notes
3	2.25-2.5m	Sparse clumped <i>Posidonia</i> with <i>Halophila</i>
4	2.50-2.75m	Sparse clumped <i>Posidonia</i> within shell grit sand with a fine cover of brown algae and few isolated rocks with small amounts of attached <i>Sargassum</i> sp. algae.
6	1.50-1.75	Mixed sparse to medium <i>Halophila</i> and <i>Zostera</i> with sparse <i>Posidonia</i> throughout.
7	1.25-1.50m	Sparse <i>Posidonia</i> with mixed <i>Zostera</i> and <i>Halophila</i> inshore.
8	1.50-1.75m	Sparse clumped <i>Posidonia</i> with small amounts of <i>Zostera</i> throughout.
9	1.75-2.00m	Sparse <i>Posidonia</i> with mixed <i>Zostera</i> and <i>Halophila</i> increasing in density inshore, with large amounts of brown algal cover on the leaves.
10	0.50-1.25m	Mixed bed of <i>Posidonia</i> , <i>Zostera</i> and <i>Halophila</i> .
12	0.50-1.75m	Mixed bed of <i>Posidonia</i> and <i>Zostera</i> with dense algal cover on leaves.



Figure 5-1. Location of Posidonia based on Marine Pollution Research (2023) findings

5.1.3 Local, Regional and State-wide conservation status

All seagrasses, including *P. australis*, are protected within NSW waters under the FM Act (NSW DPI 2007).

In NSW *P. australis* in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie are listed as endangered populations in Part 2 Schedule 4 of the *Fisheries Management Act 1994* (FM Act).

The *Posidonia australis* seagrass meadows of the Manning-Hawkesbury ecoregion ecological community is listed as endangered under the Commonwealth EPBC Act.

Condition and size thresholds provide guidance for when a patch of *Posidonia australis* retains sufficient conservation values to be considered as a Matter of National Environmental Significance (MNES), as defined under the EPBC Act.

As shown in Table 5-2, the *Posidonia australis* seagrass patches in QS Beach do not meet the key condition thresholds to be considered a MNES under the EPBC Act.

Table 5-2. Key diagnostic characteristics and condition thresholds for *Posidonia australis* seagrass meadows

Diagnostic characteristic/condition threshold		Subject site	
Diagnostic characteristic			
Occurs within the Manning Shelf and Hawkesbury Shelf bioregions (IMCRA v4.0) from Wallis Lakes to Port Hacking		YES	
Occurs in shallow sub-tidal coastal waters (<10 m) in locations with protection from high wave energy, typically, permanently open estuaries.		NO – seagrass in Spring Cove has been in a long-term decline due the effects of waves and boat/ferry wash Marine Pollution Research (2023)	
Consists of seagrass meadows ≥ 1 ha and dominated (i.e. > 50 per cent of total seagrass cover) by <i>Posidonia australis</i>		NO - only 0.7 ha	
Occurs on sand or silty mud substrate.		YES	
Condition threshold			
Meadow size	Small (≥1 – 10ha)	Moderate (≥10 – 100ha)	Large (≥100ha)
Percent seagrass cover of total meadow area	>50% and	>30% and	>20% and
Medium shoot density	100 shoots/m ²	25 shoots/m ²	10 shoots/m ²

5.1.4 Threats / Key threatening processes

There are many causes for the declines in extent of *P. australis*. Direct physical damage has occurred from dredging, sand mining, reclamation, boat moorings, boat propellers, bait gathering and from changes to the physical environment (e.g., wave heights). Losses have also occurred at some locations due to anthropogenic changes in water quality, particularly increased nutrients and reductions in water clarity (Fisheries Scientific Committee, 2010).

These latter losses are more difficult to identify and quantify. In addition, the invasive pest alga *Caulerpa taxifolia* has invaded many estuaries in NSW (NSW DPI 2009), and this may have some long-term consequences for *P. australis* within Port Hacking, Botany Bay, Sydney Harbour, Pittwater and Brisbane Waters (Fisheries Scientific Committee, 2010).

The endangered populations of *Posidonia australis* within the estuaries of Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie are under threat due to historical and current intensity of urbanisation and associated disturbance, including:

- + direct physical disturbance from dredging and reclamation activities, as well as damage from anchors, boat propellers and boat moorings (which can harm seagrass by scouring as the mooring chain is dragged across the sea bed by the moored vessel).
- + increased sediment entering waterways which can smother seagrass and block the light available for photosynthesis.

- + eutrophication (nutrient increase, especially of nitrogen and phosphorus) resulting in an increase in epiphytes which grow on the leaves, reducing the photosynthetic capacity of *Posidonia australis*.
- + indirect disturbance from altered tidal and wave regimes (associated with major dredging and foreshore reclamation) and stormwater discharges changing water quality and salinity levels.
- + the construction of foreshore structures such as pontoons, jetties and berthing areas which cause direct loss and shading that inhibits the growth of seagrass.
- + potential impacts from invasive species which may have consequences for *Posidonia australis* that is already stressed due to other disturbances.

5.1.5 Estimate of the local and regional abundance of those species

An estimate of the total former extent of the ecological community is not available, the following information has been sourced from the Conservation Advice for the EPBC Act listed community (Commonwealth of Australia, 2018).

Historical aerial photography and field observations indicate that the most significant losses of the ecological community occurred prior to the mid-1980s when the first comprehensive survey of estuarine habitats in NSW was undertaken by West et al., (1985). For example, the ecological community is estimated to have declined by 58% in Botany Bay between 1942 and 1984 (Larkum and West, 1990) and 21% in Port Hacking between 1951-1999 (Meehan and West, 2001). While changes in resource use and improved management of estuarine environments have improved conditions for *Posidonia australis* growth, there is little evidence of large-scale recovery of the ecological community (Meehan and West, 2002).

Further, Evans et al. (in prep) have documented localised losses of the ecological community of between 8-36% in Lake Macquarie, Pittwater, Sydney Harbour, Botany Bay and Port Hacking. Based on mapping by Creese et al. (2009), the current extent of the ecological community is estimated to be 14 km² (1400 ha). However, the real extent of the community is likely to be less than this given the recent estimates of localised declines (Evans, pers. comm., 2014) in the ecological community.

5.1.6 Representation in conservation reserves (or other similar protected areas) in the region

Aquatic reserves and marine parks which provide some protection for the species include: Towra Point Aquatic Reserve; Jervis Bay Marine Park; and Port Stephens-Great Lakes Marine Park and Batemans Marine Park.

The study area (Spring Cove) in which *P. australis* occurs is a marine protected area and categorised as: Aquatic reserve IUCN IV. IUCN protected area categories, or IUCN protected area management categories, are categories used to classify protected areas in a system developed by the International Union for Conservation of Nature (IUCN). This categorisation method is recognised on a global scale by national governments and international bodies such as the United Nations and the Convention on Biological Diversity.

Category IV relates to habitat or species management area. Category IV areas are to be sufficiently controlled to ensure the maintenance, conservation, and restoration of particular species and habitats—possibly through traditional means—and public education of such areas is widely encouraged as part of the management objectives.

5.1.7 Known distribution

P. australis is widely distributed, sub-tidally, in temperate and cool-temperate marine waters of southeast, southern and southwest Australia. The type locality is Georgetown, Tasmania. It occurs in extensive meadows in the Gulfs of South Australia and along the open coastline of southern Western Australia (Larkum & McComb 1989). Within NSW, the species occurs from Wallis Lake in the north to Twofold Bay in the south. Wallis Lake is the northern most extent of the species. In addition, there are a few isolated

populations found at sheltered sites along the open coastline and offshore islands of NSW (West et al. 1985, West et al. 1989).

In the Sydney and Central Coast Region of NSW, populations are found in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters, Lake Macquarie and Port Stephens (West et al. 1985). In NSW, the largest meadows are found on soft sedimentary environments, within the protected waters of marine embayments and marine dominated coastal lakes (Fisheries Scientific Committee, 2010). In these environments it is often the dominant plant community (West et al. 1985, West et al. 1989).

5.1.8 Relevant conditions

Conditions relevant to seagrasses and seagrass habitat are listed in Table 5-3 below.

Table 5-3. Conditions of existing approval relevant to seagrasses

Condition		Status
Wharf		
41	<p>If necessary, a separate application and approval under Part 5 of the EP&A Act and other relevant legislation will be required for:</p> <ul style="list-style-type: none"> a) upgrade works to the wharf, including any works that require excavation or disturbance of the seabed. This excludes use by the proposed ferry service, lighting, works identified in the PAS and minor maintenance repairs or works (as defined) that do not impact on the seabed and; and/or b) provision of additional ferry services or watercraft access to the Q Station. 	Although these works are not proposed as part of this REF, this condition is being retained to reflect future approvals pathway for these works.
42	<p>Prior to commencement of any work on or associated with the Quarantine Station wharf, or the commencement of the ferry service at the wharf, the co-proponents shall lodge an Application for Construction of Waterside Structures to the Waterways Authority for approval. This application must be submitted to the Heritage Advisor for endorsement prior to lodgement with the Waterways Authority. The application shall be accompanied by the information and comply with the requirements specified in Schedule 4. Prior to determining the application, the Waterways Authority shall consult with NSW Fisheries.</p>	As above
Seagrass monitoring program		
184	<p>The co-proponents shall develop and implement a program to monitor the density, condition and extent of seagrass beds in the wharf area, in consultation with the Waterways Authority. Details of the methods and approaches to be used in monitoring seagrass beds will be submitted to NSW Fisheries for approval prior to monitoring</p>	Details of the methods and approaches to be used in monitoring seagrass beds were approved by the NSW Department of Primary Industries (DPI) Fisheries in July 2023.

Condition		Status
	commencing.	
185	Implementation of the seagrass monitoring program is to occur prior to commencement of the ferry services to the site. Monitoring must be undertaken by a suitably qualified marine ecologist.	A review of past surveys conducted on behalf of Mawland (the former Q Station lessee), collection of 2003 benchmark data and development of the approved seagrass monitoring program was undertaken by Marine Pollution Research Pty Ltd (MRP).
186	Adaptive management: If the monitoring of the seagrass beds indicates a significant reduction in the density, extent or condition of the seagrass beds, and NSW Fisheries is satisfied that such decreases are either fully or partially related to the activity, the co-proponents must consult with NSW Fisheries to implement appropriate measures to reduce impacts within a specified timeframe, and to provide habitat compensation at a ratio of 2:1.	Monitoring conducted by MRP in 2023 does not indicate any significant reduction in the density, extent or condition of the seagrass beds in the study area that can be associated with operation of Q Station (see Section 5.1.9).
187	The co-proponents shall ensure that the undertaking of the activity complies with any measures specified in condition 186.	Ongoing

5.1.9 Impact assessment

Marine Pollution Research (2023) provide a synopsis of past seagrass monitoring programs and conducted January/February 2023 seagrass and aquatic ecological survey in Spring Cove (adjacent to QS Beach). The following was concluded:

“whilst previous ferry and other longer term vessel activity associated with Quarantine Station wharf usage have contributed to localised seagrass loss via propeller wash disturbance of sea-beds that have led to destabilised seabed sediments, plus fragmentation and loss of seagrass offshore out from the wharf head, seagrass in Spring Cove/Quarantine Bay has been in a long-term decline due the effects of waves and boat/ferry wash originating from activities further afield and from more direct impact from vessel anchoring into seagrass beds, notwithstanding the provision of No Anchoring buoys.”

A long-term decline in core *Posidonia australis* beds is also noted in comparison to core inshore mixed *Zostera* and *Halophila* beds, whilst carrying the scars of previous disturbance, which have been able to re-grow into previous areas of seagrass loss in deeper water.

The comparison of the past surveys, DPI Fisheries mapping projects and the more recent 2023 survey provided evidence of how precarious re-growth can be for these species (i.e., when insufficient time is available for the species to consolidate into well-matted core beds with firm root systems).

That is, without long-term consolidated regrowth, it is more likely that the core inshore beds at QS Beach will remain relatively steady in overall areal extent (if anchoring associated losses can be checked). However, offshore re-growth will most likely continue to fluctuate more rapidly in response to changing seasonal climatic conditions.

MPR also recommended that, whilst overall annual surveys would need to concentrate on seagrass condition, the upgraded Condition 184 study program will also need to include consideration of White’s seahorse presence as it is now listed as a threatened species in Sydney Harbour and is known from seagrass beds in Quarantine Bay.

5.2 *Eucalyptus camfieldii*

5.2.1 General description

Eucalyptus camfieldii, also known as Camfield's Stringybark, varies between a mallee-like shrub of 4 m or less in height to a straggly tree up to 9 m high. The greyish-brown bark is rough, fibrous, stringy, irregularly and coarsely fissured. The flowers are white and the juvenile leaves are round to heart shaped and roughly hairy. Adult leaves are broadly lance-shaped, 10 cm long by 3 cm wide and glossy green.

The species is known to occur mostly in small, scattered stands near the boundary of tall coastal heaths and low open woodlands of the slightly more fertile inland areas. The distribution of this species overlaps with a number threatened ecological communities, including the Eastern Suburbs Banksia Scrub (which is present within the subject site, refer Section 4.1.3). Several specimens of Camfield's Stringybark are located near the first fork of the entrance road (off the North Head Scenic Drive) within the subject site (see Figure 5-2).

5.2.2 Distribution

The Q Station is not located at the limits of the species' known distribution, which extends from Norah Head, on the NSW Central Coast, to Waterfall and the Royal National Park, south of Sydney. Within this area it occurs in scattered locations including Peats Ridge, Mt Colah, West Head, Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites within the Royal National Park. This species occurs within the Hunter–Central Rivers, Hawkesbury–Nepean, and Sydney Metro (NSW) Natural Resource Management Regions. Population sizes are difficult to estimate, as this species has extensive lignotubers of up to 20 m across with a number of stems, making it appear that there are a number of different individuals (Commonwealth of Australia 2008).

5.2.3 Conservation status

Camfield's Stringybark is listed as Vulnerable under both the BC Act and EPBC Act. The species was originally known from as far south as Bulli Pass (near Wollongong) and as far north as Gosford. In NSW, this species is now known only from a very few small stands confined mainly to the national parks north and south of Sydney. Populations are known at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park (EPBC Act SPRAT).

Camfield's Stringybark is known to occur in the following reserves:

- + Sydney Harbour National Park
- + Heathcote National Park
- + Brisbane Waters National Park
- + Ku-ring-gai National Park
- + Munmorah State Conservation Area
- + Garawarra State Conservation Area
- + Lion Island, Long Island and Spectacle Island Nature Reserves
- + Royal National Park.

5.2.4 Threats

Threats identified in the TBDC and relevance to the facility's operation are outlined as follows:

Loss of habitat through clearing for development	Threat not present
Weed invasion	Weed infestations present
Disturbance from recreational users (mainly	Threat not present

relating to 4WD users)	
Inappropriate fire regime	Fire regimes are managed by NPWS
Myrtle rust fungus and Phytophthora impacting on species survivorship	Potential to occur (monitoring in place)
Climate change (prolonged dry periods with threat of Myrtle Rust) makes this species highly vulnerable to local extinction	Potential to occur (monitoring in place)

5.2.5 Impact assessment

The Q Station Monitoring Report 2017-2022 (NPWS) identifies that the number of Camfield’s Stringybark within the QS lease area was within the acceptable range (3 and above) in 2019, 2020, 2021 and 2022, with all three specimens in good health.

The only activities proposed in the vicinity of this species are vehicle and pedestrian movements, which have been in effect since 2006. However, future prescribed hazard reduction burns have the potential to impact on the species. Hazard reduction burns in 2020 occurred in Camfield’s habitat areas (refer Figure 3-5). Potential clearing for fuel reduction to maintain asset protect zones (APZs) will be subject to a separate approvals process led by NPWS

The proposed ongoing operation of the facility is not anticipated to directly, or indirectly, impact on this species providing monitoring and management of the species continues compliantly. The ongoing operation of the facility is considered unlikely to exacerbate any of the listed threatening processes.

5.3 Acacia terminalis subsp. terminalis

5.3.1 General description

Acacia terminalis subsp. *terminalis* (Sunshine Wattle) is an erect or spreading shrub, 1-5 metres tall, with pale yellow flowers and seed pods 3-11 cm long. The small branches (branchlets) are angled and have longitudinal ridges. The leaves including stalks (petioles) are 0.5-2.1 cm long and contain between 2 and 5 pairs of pinnae (=leaflets). Differs from more widespread subspecies by being hairier, possessing thicker flower stalk and wider seed pods.

Sunshine Wattle has a very limited distribution that extends for approximately 23 km from the northern shores of Sydney Harbour to Botany Bay, in the former local government areas of Manly, Mosman, Woollahra, Waverley, Randwick, and Rockdale.

Habitat for the listed Sunshine Wattle is generally sparse and scattered through its limited distributional range in the eastern suburbs of Sydney.

Most areas of vegetation which do or might support this species are small and isolated, and most are highly modified or disturbed due to surrounding urban and residential development. Even in the largest area of vegetation and habitat for this species (North Head), the Sunshine Wattle appears to be located primarily in areas of disturbance, adjacent to roads and carparks (at least within the Quarantine Station). Although these areas are not dominated by weeds, they are characterised by a range of introduced species in addition to the native vegetation (Gunninah 2003).

The Q Station Monitoring Report 2017-2022 (NPWS) identifies that Sunshine Wattle including seedlings were recorded within the acceptable range (greater than 12) in 2018, 2019, 2020, 2021 and 2022. Monitoring was not undertaken in 2017. In 2019 a comprehensive survey was conducted across the lease area, which identified new locations where the species is present. These locations were incorporated in the ongoing monitoring program and are shown in Figure 3-5.

5.3.2 Distribution

Sunshine Wattle has a very restricted distribution that extends for approximately 23 km from the northern shores of Sydney Harbour to Botany Bay. Within this distribution, it is known from 27 populations, which are subdivided into 53 sites. All sites occur in the former LGAs of Manly, Mosman, Warringah, Woollahra, Waverley, Randwick, and Rockdale. The subspecies has an extent of occurrence of approximately 200 km².

The Q Station is not located at the limits of the species' known distribution, which extends further north into the former Warringah LGA and south to the former Rockdale LGA. Most records are from the Port Jackson area and the eastern suburbs of Sydney (i.e., North Head, Middle Head, Dover Heights, Parsley Bay, Nielsen Park, Cooper Park, Chifley, Watsons Bays, Wollstonecraft and Waverley).

5.3.3 Conservation status

Sunshine wattle is listed as Endangered under both the BC Act and EPBC Act. The National recovery program (DECCW, 2010) describes 53 sites where the species occurs, of which only four sites occur on private land (two owned by St. Patricks College proximal to the subject site) and 15 sites where the species occur within Sydney Harbour National Park and are zoned as National Park (including North Head).

5.3.4 Threats

Key threatened processes listed under the EPBC Act and threats identified in the TBDC and relevance to the facility's operation are outlined as follows:

Clearing of native vegetation	Threat not present
Invasion, establishment and spread of <i>Lantana camara</i>	Weed infestations present – <i>L. camara</i> within QS lease area
Disturbance from recreational users	Potential to occur (visitor code of access in place)
Ecological consequences of high frequency fires	Fire regimes are managed by NPWS
Infection of native plants by <i>Phytophthora cinnamomi</i> disease	Potential to occur (monitoring in place)
Climate change (prolonged dry periods because of climate change combined with threat of Myrtle Rust) makes this species highly vulnerable to local extinction	Potential to occur (monitoring in place)
Possible in-breeding due to too small and isolated populations	Potential to occur

5.3.5 Impact assessment

The Q Station Monitoring Report 2017-2022 (NPWS) identifies that the number of Sunshine Wattle specimens within the QS lease area were recorded within the acceptable range (greater than 12) in the 2018-2022 period.

The Q Station Monitoring Report 2018-2019 – updated (SNC-Lavalin, 2022) identified unauthorised vegetation clearing, which was addressed through ‘vegetation identification and clearing’ refresher training provided to landscape contractors approximately every three months via toolbox talks, which commenced in mid-2018.

Despite the refresher training included the identification of Sunshine Wattle (SNC-Lavalin, 2022), the Q Station Monitoring Report 2017-2022 (NPWS) identified the following impacts on the species:

- + Previous QS management cleared one plant in 2019. NPWS investigated and the implemented action was to provide further education to the lessee’s staff and contractors.
- + In 2021 Asset Protection Zone (APZ) maintenance impacted on several plants. As part of the subsequent investigation and treatment NPWS worked with the Saving Our Species program to remediate the area and plant approximately 100 new seedlings through a community planting initiative incorporating a Back to Country event.

Since this time, the new QS management (from 2022) are actively working to protect Sunshine Wattle and have participated in flagging all plants to assist with ongoing site management (NPWS 2017-2022).

Given the nature of past impacts to the species, the ongoing conservation of the species (within the subject site) should be subject to more stringent controls, at a minimum:

- + Raising the acceptable range to incorporate a commensurate quantity associated with the establishment of the 100 seedlings planted
- + Ongoing and new employee induction training and record keeping
- + Enforcement of penalties under Section 2.4 of the BC Act

5.4 Camfield’s Stringybark & Sunshine Wattle guidelines

5.4.1 Consent conditions

Conditions relevant to Camfield’s Stringybark and Sunshine Wattle are Table 5-4 below.

Table 5-4. Conditions of existing approval relevant to Camfield’s Stringybark and Sunshine Wattle

Condition		Status
Flora and fauna		
160	‘Any areas proposed for vegetation clearance or removal are to be surveyed by a suitably qualified person for the presence of hollow-bearing trees <u>and threatened flora</u> , which are to be clearly tagged and identified for retention.’	No longer applicable as no vegetation clearing proposed
Monitoring and auditing program		
217	(e) flora and fauna: “...shall include general monitoring during construction and operation phases, as well as specific strategies for monitoring threatened species ...”	Annual monitoring is conducted by NPWS

Condition		Status
SCHEDULE 9. Environmental Management Plan		
191	<p>(h) mapping of key environmental features and proposed environmental safeguards, to include:</p> <ul style="list-style-type: none"> + vegetation cover and threatened species locations/habitat 	<p>Vegetation cover and threatened species have been mapped but require updating (with reference to TECs and the extent of various PCTs in the QS lease area).</p>
	<p>(i) specific objectives and strategies for the main environmental management elements. This should, at a minimum, identify what the issue is, compliance and best practice requirements, the action required, who will undertake the action and when.</p> <ul style="list-style-type: none"> + flora is one of the listed main elements 	<p>Both species are monitored annually by NPWS with performance targets identified as follows:</p> <ul style="list-style-type: none"> + Camfield's stringybark: 3 and above + Sunshine wattle: 12 and above <p>Best practice requirements have been integrated into induction programs for landscape maintenance personnel</p>



Figure 5-2. Location of Camfield's Stringybark and Sunshine Wattle (relevant to the subject site)

6. Threatened Fauna

The following sections relate to threatened fauna species that were assessed in the proposal's Flora and Fauna Assessment Report (écologique 2024) as warranting inclusion in the SIS for the following reasons:

- + The subject site contains an Area of Outstanding Biodiversity Value (AOBV), which was determined for the Manly little penguin population
- + Threats to the species exist within the subject site (e.g., the long-nosed bandicoot, red-crowned toadlet and eastern pygmy possum), and/or
- + The species was not considered in the original EIS and does not have any related CoPA conditions and have not been included in the ongoing monitoring program for the QS lease area.

6.1 Little Penguins (*Eudyptula minor*)

6.1.1 General description

Eudyptula minor (the little penguin) is the smallest of all penguins (~30-40 cm), generally weighing between 1 and 1.2 kg and standing about 30cm tall. By comparison the Emperor Penguin, which is the largest penguin in the world, stands over 110 cm and can weigh 30 kg. Adult birds have steel blue feathers on the back, head and wings with white underparts. The feather bases are coated with thick down for insulation in the water. Males are generally larger and heavier than females. The average lifespan is about seven years and birds mature at about three years. Some birds in captivity have been known to live for 21 years (Department of Environment and Heritage, 2005).

Little penguins consume about their body weight every day (Department of Environment and Heritage, South Australia 2023). They feed on small schooling fish when feeding chicks but they may also feed on krill and several species of cephalopods at all stages of breeding and jellyfish. This variability in the diet is also found in their trophic interactions where penguins can reduce the prey trophic range in response to years of low breeding success and segregate foraging areas within the same colony (BirdLife International 2023)

Most penguins return from the sea after dark. They can often be heard calling from out in the water and usually come ashore in small groups pausing briefly before heading off to individual burrows. Due to their movements on land penguins are often mistakenly thought of as nocturnal. They do in fact feed at sea during the day returning to the colony to rest. Much communication occurs as the penguins return from the sea-calls from the sea, calls on land, greeting and communication with other birds, territorial disputes and so on (Department of Environment and Heritage, South Australia 2023).

The nest site is typically a rocky burrow or shelter, although nests under dense vegetation are common where there is competition for burrows. Artificial burrows and nest boxes have been successfully made for little penguins with a high occupancy rate soon after installation (Department for Environment & Heritage, 2005). A range of nest sites are utilised by the little penguins at Manly including under rocks on the foreshore, under seaside houses and structures, such as stairs, in wood piles and under overhanging vegetation including lantana and under coral tree roots, and nest boxed installed by the NSW NPWS.

The species exhibit six main breeding stages: courtship, pre-laying exodus, pre-laying, incubation, guard and post-guard; followed by moulting and inter-breeding stages. When feeding chicks, some parents make more foraging trips than their mates. This situation represents the norm (72% of cases), rather than the previously expected equal parenting. Individuals can also alternate between two consecutive long foraging trips and several shorter ones throughout the chick-rearing period (BirdLife International 2023).

Short trips allow for regular food provisioning of chicks (high feeding frequency and larger meals), whereas longer trips are triggered by a parent's low body mass and therefore the need to replenish its energy reserves. Little penguins form groups when crossing the beach to nesting sites and individuals seem to

choose their travelling partners. When foraging, some individuals can take advantage of human-made features, like ship channels to aid in their foraging (BirdLife International 2023).

6.1.2 Distribution

The little penguin is relatively common in the waters of southern Australia, breeding mainly on offshore islands. The colony in North Sydney Harbour represents a small fraction of the NSW population but is the only known breeding colony on the mainland in NSW (NPWS 2000).

The species is endemic to Australia and New Zealand. In Australia, the species occurs from Western Australia (Carnac Island, 32.1210° S, 115.6621° E) to New South Wales (Broughton Island 32.61580°S 152.31400°E). The distribution is not continuous, as breeding colonies are absent from some sections of the southern coast of Australia (BirdLife International 2023).

While the population at Manly is endangered, the Q Station is not located at the limit of the species distribution, which extends from Port Stephens in NSW (but offshore), along the coast through Victoria, South Australia, Tasmania and as far as Fremantle in Western Australia.

6.1.2 Conservation status

The NSW Scientific Committee listed the population at Manly (in North Harbour) as endangered in January 1997. In December 2002 critical habitat was declared for the species that extends around Manly Point and from Cannae Beach to the eastern side of Little Manly Point (NPWS 2002). A recovery plan was prepared for the population, which documents known threats and management objectives (NPWS 2000).

Areas of declared critical habitat under the now repealed *Threatened Species Conservation Act 1995* (TSC Act), including little penguin and Wollemi pine declared areas, are now considered Areas of Outstanding Biodiversity Value (AOBV). AOBVs are special areas with irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. The relevant legislative provisions for AOBVs are Part 3 of the BC Act and BC Reg.

As shown in Figure 6-1, the little penguin's critical habitat is in two AOBV areas:

- + Area A starts from west of Collins Beach and extends to the northern side of Cannae Point. It includes Collins, Store and QS Beaches to the northern side of Cannae Point. The terrestrial boundary of the critical habitat in Sydney Harbour National Park includes ridgetop areas where penguins currently nest or could potentially nest.
- + Area B starts at 11A Oyama Avenue and extends around Manly Point to 26 Addison Road. The land side of the critical habitat includes the area from the mean high watermark, up the rocky foreshore slope to the beginning of the ridgetop in residential areas. The rocky foreshore upslope to the boundary of formed residential backyards is included as critical habitat, but formed backyards and residential areas are not included.

The critical habitat also includes the harbour (extending 50m out from the mean highwater mark) to make it easier for penguins to get to nesting areas. Parts of this aquatic zone include seagrass beds that are likely to be important feeding areas, especially during the rearing of chicks when little penguins are known to seek food closer to their nests.

The species is globally classified as 'least concern' on the IUCN red list, which is justified by a stable population trend. However stable trend should be taken cautiously as 60% of the sites have an "unknown" population trends due to data deficiency.

In Australia, there is a decrease in the population size in NSW and South Australia while Tasmania is data deficient. Little penguin population declines up to 80% have been recorded in South Australia over the past two decades (DEWNR 2016).

Populations are stable in WA although they are particularly vulnerable due to rising sea temperatures, which in turn have resulted high mortalities. In New Zealand, the situation of the species remains unclear due to inconsistent monitoring efforts over large parts of the country.

Victoria has a large population on Phillip Island (around 40,000), which is well above the population size of fewer than 10,000 to meet a 'vulnerable' classification on the IUCN red list.

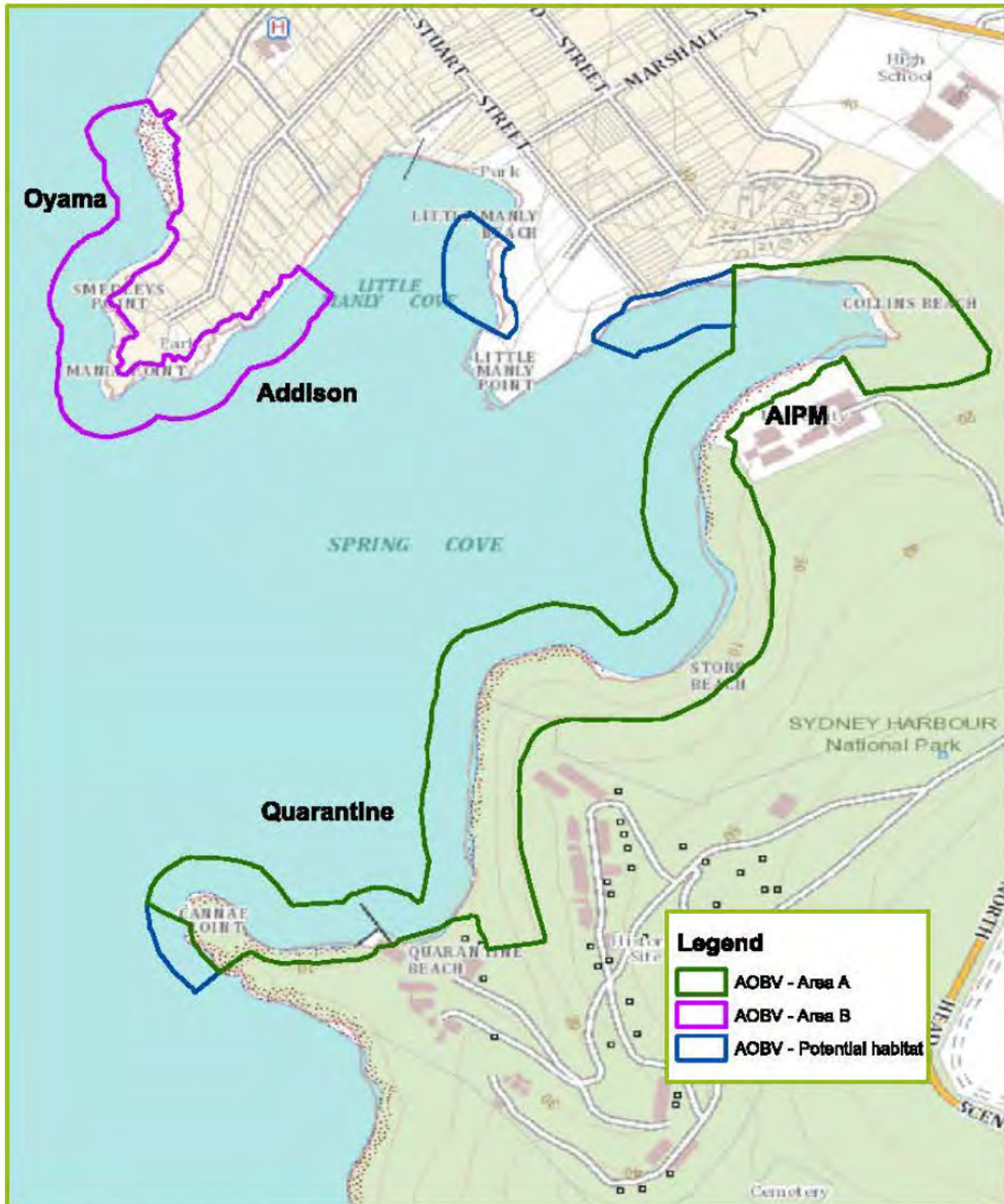


Figure 6-1. Little penguin critical habitat

6.1.3 Key threatening processes

The Manly little penguin population is considered endangered due to an extremely small number of individuals, its disjunction from other populations, its occurrence in Sydney Harbour and a reduction in its former range on the mainland (NPWS, 2002).

Key threatening processes described in the Recovery Plan for the Endangered Population of Little Penguins (*Eudyptula minor*) at Manly (NPWS 2002), threats listed in the Australian Government’s Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020), and the threat relevance is outlined below and discussed in the following subsections.

Habitat loss and modification	Threat is not present in QS lease area but has occurred in study area (refer Section 6.1.3.1)
Disturbance around nesting areas is another threat to the population, which include: <ul style="list-style-type: none"> + Increases in noise and light from nearby buildings and waterway activities + Lights shining onto nesting areas from boats or buildings may disorientate or even prevent birds from returning to shore + Recreational watercraft in particular powered vessels, including jet-skiers, need to be aware of the marine regulations, such as the 100m wide 4 knot speed limits 	Noise and light pollution present throughout study area (refer to Sections 6.1.3.2 and 6.1.3.3) Threat is present in Spring Cove (refer to Section 6.1.3.4)
Pollution inputs into Sydney Harbour from stormwater, sewerage overflows, watercourses and atmospheric fallout affect water quality and substrate composition and may affect penguin health	Potential threat (refer to Section 6.1.3.5)
Predation - predators such as dogs, cats, and foxes are known to take penguins from shallow burrows and as they move between the water and their nesting habitat.	Threat is present (refer to Section 6.1.3.6)
Climate change	Threat is present (refer to Section 6.1.3.7)
Prey depletion - long-term demographic studies show that seabird populations (in general) may suffer from competition with fisheries (e.g., harvesting of marine resources can affect marine ecosystems and predator-prey interactions by the removal or redistribution of biomass central to pelagic food webs. In particular, fisheries targeting forage fish and euphausiids (krill) may be in competition with seabirds for food resources.	Potential threat to the species beyond the study area
Heavy metals and other contaminants	Unknown - potential threat to the species within and beyond the study area

6.1.3.1 *Habitat loss and modification*

Habitat loss is most commonly associated with development, which is not an existing threat within the QS lease area. The ongoing operation of the facility does not involve any new construction that would impact on the little penguin habitat.

Historically, numerous instances of anthropogenic modifications to existing foreshore areas within the study area have occurred to the detriment of the little penguin. These have included construction of seawalls, infilling/concreting of access and burrows beneath buildings, and other artificial barriers preventing access to nest sites.

This is no longer a threat with stringent development controls applicable to landowners in Manly Point, penguin habitat is known as 'Declared Area B'.

Under NSW legislation, exempt and complying development cannot be undertaken on properties affected by an Area of Outstanding Biodiversity Value (AOBV). This means that a development application will be required for any construction or demolition works on properties affected by the AOBV.

6.1.3.2 *Noise*

An assessment of potential noise impacts of the proposal on little penguins was undertaken by Biosis to support the MOD 3 EIS, which approved the introduction of ambient dining music at the Boilerhouse Restaurant.

The assessment reviewed available literature and consulted with the leader of a team undertaking research on Little Penguin at St Kilda in Victoria. The breeding colony in St Kilda approximately 5kms from Melbourne CBD, where they nest between large boulders that form the artificially constructed breakwater located at the end of St Kilda pier. First recorded breeding in 1974 and now support 1200 adult penguins (2015).

Noise pollution from St Kilda Kiosk and Little Blue Restaurant both located within the historic St Kilda Kiosk building at the entrance to the breakwater. Since 2006 the building has featured a large outdoor dining space and has broadcasted amplified music, particularly on Saturday nights when bands and DJs occasionally perform at the venue. Little penguins have been recorded nesting within 2m of the kiosk building and anecdotal evidence also suggests that the density of penguin burrows remains consistent across the entire length of the breakwater. Thus, proximity to noise appears to be having little if any impact on this population.

This population has consistently exhibited higher breeding success and higher body mass than those from Phillip Island population, this believed largely due to the presence of a local and reliable food source in Port Phillip Bay. Exposure to anthropogenic noise is therefore likely to be a negligible factor affecting population dynamics and body condition compared to other major documented factors such as prey availability, predation, climatic conditions, litter entanglement and oil spill events.

It is understood that the Manly population is not subject to tourism. However, correlations between areas with and without public access include that found by Dann (1992).

The Biosis report also reviewed an analysis of breeding data at Port Phillip Island in Victoria (Dann 1992). This population has been the subject of a large number of studies. It has an estimated 32,000 breeding little penguins and is also the focus of a major tourism operation that attracts over 500,000 visitors each year. Analysis of breeding data demonstrated that rates of breeding activity and recruitment of little penguins nesting within the tourist areas, and therefore exposed to human visitation, artificial lighting and increased background noise, are not significantly different to rates observed in areas without public access.

These observations are consistent with studies from other penguin populations that have demonstrated that environmental factors such as prey availability exert greater effects than human disturbance (e.g., Carlini et al. 2007).

lasiello Colombelli-Négrel (2023) investigated the behavioural and physiological responses of little penguins to introduced anthropogenic noises resulting from coastal development (specifically, construction noises) v. rainfall noises (control) and the potential impacts of construction noises on little penguin breeding success. The rainfall noises were played at ~ 60-65 db (measured at 1m) and the construction sounds were played at ~70 db (measured at 1m) with peaks of ~75-80 db when a jackhammer was used.

The methods used in this study were undertaken using dummy eggs containing microphones installed into clutches without removing any of the natural eggs. 33 adult little penguins from 26 different nests were tested. This study showed that little penguins spent significantly more time in vigilance (but showed no increase in heart rate) during the construction noise playback than during the rainfall playback, supporting the distracted prey hypothesis⁴. However, little penguins did not increase their heart rate in response to the disturbance.

This result aligns with a study by Derose-Wilson et al. (2015) showing that Wilson's plovers increased their vigilance, but not their heart rate, when aircrafts flew overhead, but contrasts with other studies in seabirds. This supports the distracted prey hypothesis (Chan *et al.* 2010) because the stimulus still caused individuals to become distracted, with a clear deviation in attention and potentially brain function, but not the anti-predator hypothesis that suggests that humans (and related disturbances) should elicit a response like that towards predators.

One hypothesis to explain these results is that little penguins did not perceive the construction noises as a substantial threat and responded to the noise with increased vigilance only because of its novelty. Alternatively, the stimulus was too short to exhibit a stress response. A study by Larcombe (2016) found that little penguins displayed a more intense response when approached by researchers than to playback recordings. Therefore, the lack of visual threat could also have led to the low response observed in the lasiello Colombelli-Négrel study.

The above studies are just a selection of many scientific research projects that provide insight into potential noise impacts on the little penguin.

6.1.3.3 Light

Costello and Colombelli-Négrel (2023) investigated how human activities at night influenced little penguin numbers and behaviours (specifically return time, number of vocalizations and time spent in vigilance) on Granite Island, a declining population in South Australia. Data was combined from regular night surveys with continuous video and audio monitoring to assess the impact of human activities on the species.

The use of white light (i.e. from torches or camera flashes) by people was the most frequent activity recorded at night (recorded on 65% of the monitored nights). Fewer penguins were found on land at night when *Canis lupus familiaris* (dogs) were present, but not when the number of people increased, when concerts occurred, or when white lights were used.

Little penguins were observed more often returning late from sea at night when dogs were present and when white lights were used, but not when concerts occurred. However, an increase in penguin vocalizations at night correlated with the presence of dogs and the occurrence of concerts, whereas penguins vocalized less when white lights were used. The time little penguins spent in vigilance did not correlate with any of the disturbances analysed.

Camera flashes can blind a penguin for up to five minutes making them vulnerable to predation (DEWNA 2016).

⁴ The "distracted prey hypothesis" proposes that external stimuli – such as sounds – are capable of hijacking finite resources, thus impairing the prey's ability to detect and react to approaching predators (Chan et al., 2010).

Torches and camera flashes are not permitted near penguin habitat in the QS lease area and the design and use of lights at the facility are conditioned and currently reported in the Infrastructure Control Plan – Part 1 which was approved by the DECC on 5 November 2008.

It is recommended that this plan be reviewed and where applicable revised with consideration to the National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds January 2020 Version 1.0 (see Section 6.1.7). Relevant conditions that aim to mitigate light spill and light impacts on little penguin) are listed in Table 6-3.

6.1.3.4 Recreational watercraft

Increasing human access to marine areas used by little penguins could also result in more injuries/deaths associated with collisions with watercraft (DEWNA, 2017).

Taronga Wildlife Hospital provides information to NPWS on deaths and injuries on all penguins delivered to them. Most deaths are not able to be attributed to a particular cause, but for those where this is possible, boat strike is one of the most common causes since 2010 (O'Neill, 2024).

Little penguins will gather in the bay, known as 'rafting', before they come into shore. It is at this time that watercraft easily run through these rafts.

NSW Maritime have implemented a four-knot boat operation limit in Spring Cove to minimise the rise of boat strike on the little penguin. There are also restrictions relating to anchoring. Boats are prohibited from anchoring within 50 metres of the shore in the Spring Cove area.

The Quarantine Station Wharf and ferry-based transport to and from the facility is not currently in operation and therefore the potential impacts on the little penguin from this mode of transport is not assessed.

Boat-based arrivals to the facility are currently limited to standup paddle boards (SUPs), kayaks, and small dinghies / zodiacs launched from larger water vessels anchored off the shore. These boat-based activities are of negligible risk to the little penguin as they are typically operated during daytime hours outside of the penguins' onshoring and offshoring.

6.1.3.5 Water quality pollution / contaminants

The impacts of pollutants on the little penguin are less widely studied and reported. Most likely because such studies require autopsy and expensive laboratory analysis.

DEWNA (2016) report trace metals and metalloids (mercury, lead, iron, arsenic and others) been found in the blood and feathers of little penguins in Australia and pesticides found to accumulate including DDT (dichloro-diphenyl-trichloroethane) in South Australia. However, the effects of metals, metalloids and pesticides on mortality of little penguins are unknown.

Wells et al. (2024) investigated the presence of PFAS in scat-contaminated soils from nests, plasma and eggs of little penguins around Tasmania and explored possible health related perturbances. PFAS were found to be widespread in soils from nests containing scats and in the birds themselves, across their range. Further, evidence was found that some PFAS, even at the low concentrations related to haematological indicators of health in little penguins, and that this appears to be associated with anthropogenic activities (urbanisation).

Urbanisation of breeding sites was positively associated with PFOS and PFHxS concentrations in soils and blood. The number of erythrocytic⁵ nuclear abnormalities in males was positively associated with PFOS. These findings are the first to document the presence of PFAS in this resident seabird nesting and foraging

⁵ A type of blood cell that is made in the bone marrow and found in the blood. Erythrocytes contain a protein called haemoglobin, which carries oxygen from the lungs to all parts of the body.

close to anthropogenically modified habitats, and demonstrate that even in low concentrations, PFAS may have detectable relationships with penguin health.

As little penguins are inshore foragers (and in the absence of local foraging ecology knowledge), Wells et al. (2024) suggest that coastal prey species may also be subject to the localised urban sources of pollutant run off. Spatial diet segregation in little penguins has been documented in other populations (Chiaradia et al. 2012), and it is likely that localised urban intensity of breeding sites acts as a proxy for trophic bioaccumulation of pollutants.

This is concerning for locally foraging, urban-breeding marine predator populations, including the population at Manly.

6.1.3.6 Predation

The Little Manly population has historically suffered from urban dog predation, including the following incidents:

- + Several penguins killed by a single dog from an anchored vessel in 1985
- + Eight penguins killed in a residential street over one night in 1995
- + Seven penguins killed at Federation Point. Autopsy examination of the injuries suggests the deaths were caused by an urban dog (reported in the 2010-11 annual monitoring report)

The start of the 2015/16 breeding season a fox started killing penguins in the area around Collins Beach and the AIPM and moved on to the Quarantine Station. Over about 10 days, 27 penguins were killed. A management program was quickly put in place to catch or kill the fox, involving people regularly patrolling areas used by the penguins, soft-jaw traps laid, shooters stationed near colonies at night, cameras deployed and monitored regularly, dogs to search for fox scent and fox lights to simulate human presence on site at night.

The impact of the fox predation incident on little penguin breeding was dramatic. The loss of 27 or more penguins an obvious immediate loss in breeding potential for this and subsequent seasons. In addition, the increase in human disturbance within and around the breeding areas, as well as the presence of sniffer dogs and the fox itself, all had potential to reduce breeding activity and success of the season.

The impact of natural predation on the population at Manly is unknown. An independent report on little penguins in South Australia (DEWNR 2016) identified the various threats and pressures operating on each colony and then prepared a risk assessment for each colony based on the assessed likelihood and consequence of each pressure (threat) effecting that colony.

While many of the South Australian colonies support tourism specifically catering to little penguin experiences, many of the identified threats are applicable to the North Harbour population with natural predation by sea eagles, seals, goannas and snakes identified.

6.1.3.7 Climate change

Climate change is a threat that impacts many marine organisms including seabirds. The 'Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases' has been declared a Key Threatening Process under the EPBC Act. The threat is described as reductions in the bioclimatic range within which a species or ecological community exists due to emissions induced by human activities of greenhouse gases. The listing of this threat recognises that it is occurring at a continental scale. Components of the process include:

- + temperature rise;
- + changes in rainfall patterns;
- + changes to the El Niño Southern Oscillation; and
- + sea level rise.

Consequences to seabirds, including the little penguin could include negative impacts from an increase in extreme weather events, reduced or changed prey abundance and distribution, and decrease in nesting habitat (Commonwealth of Australia, 2020).

In general, environmental variability affects population processes among penguins, most often reported as through the distribution or availability of their mid-trophic-level prey. Direct evidence that climate change affects penguins is scarce. This is mostly because biological monitoring data are relatively short term (the World Meteorological Organization often uses a climatological baseline of 30 years), and it remains difficult to ascertain the causes of recently observed changes in penguin populations. However, penguins appear to respond to changing environmental conditions in the short term through modifications in breeding parameters and in the long term by altering their distribution and abundance (Trathan *et al.* 2015).

Little penguin breeding and survival has been found to be influenced by warmer sea surface temperatures, as well as changes in the dynamics of ocean currents and wind components (Chambers *et al.* 2009a, 2011, 2012, Chambers 2004, Cannell *et al.* 2012, Mickelson *et al.* 1992, Cullen *et al.* 2009).

In Western Australia, rising sea-surface temperatures and periods of stronger Leeuwin Current⁶ have been correlated with lower abundances of fish and poor breeding outcomes in little penguins. Specifically, Cannell *et al.* (2012) found sea surface temperatures associated with poorer breeding including lower fledging success, fewer chicks per pair and a lower mean mass of chicks at fledging at nestbox breeding sites that have been monitored for over 30 years.

Also in Western Australia, marine heatwaves have been correlated with high incidence of starvation in 2011, mid-2017, and in mid-2021, with little penguins shown to catch fewer prey in warmer conditions (Carroll *et al.* 2016, Cannell 2023).

At Phillip Island, high sea surface temperatures before the breeding season have been correlated with earlier laying in little penguins, a greater number of chicks, and heavier chicks, as well as increased survival in the first year, but lower survival in adults (DEWNR 2016). Conversely at Phillip Island, during the 2019 moulting season, hundreds of little penguins died after several days above 35 degrees on Phillip Island, despite the Nature Parks' best efforts to save them. It was the greatest heat-related loss on record (reported by various media outlets).

Oceanographic change may lead to a mismatch between plankton and the small pelagic fish that are also penguin prey. Increasing terrestrial temperatures in the spring and summer months can cause fatal hyperthermia in both chicks and adults (BirdLife International 2023).

Rising sea levels will also affect the availability of nesting habitat DEWNR (2016) through flooding of burrows and erosion of foreshore sites.

6.1.3.2 Human handling

Larcombe (2015) aimed to quantify the effects of human disturbance on little penguins at Oamaru, New Zealand, by measuring heart rate (HR) to measure responses to typical researcher and visitor interactions. Researcher interactions included: human speech, band checking, and weighing, with penguin call playback used as a control.

Little penguins at Oamaru were found to have stronger HR responses to being weighed than to hearing penguin calls or human speech. However, some individual penguins reacted as strongly or more strongly to having their band checked than to being weighed. There was some correlation between HR responses and corticosterone responses, suggesting that individual penguins respond consistently on a shy-bold personality continuum.

⁶ The Leeuwin Current is a warm ocean current which flows southwards near the western coast of Australia. It rounds Cape Leeuwin to enter the waters south of Australia where its influence extends as far as Tasmania.

Carroll et al. (2016) measured the physiological and behavioural response of little penguins that were naïve to human activity over 30 minutes of capture and handling. Relationships between corticosterone secretion, behaviour, sex and time of day were assessed to characterise the determinants of the natural stress response. These were then compared to the response of these naïve penguins with the responses of female little penguins that had been exposed to research activity (bimonthly nest check and weighing) and to both research activity (monthly nest check and weighing) and evening viewing by tourists.

It was found that corticosterone concentrations increased significantly over 30 minutes of capture, with naïve penguins demonstrating a more acute stress response during the day than at night. Penguins that had previously been exposed to handling at the research and research/visitor sites showed elevated corticosterone concentrations and consistently more aggressive behaviour after 30 minutes compared with naïve birds, although there were no significant differences in baseline corticosterone concentrations.

Carroll et al. (2016) concluded that these little penguins have not habituated to routine capture, but rather mount a heightened physiological and behavioural response to handling by humans.

Klomp et al. (1991) found that nesting boxes for little penguin breeding that were subjected to human disturbance were used less often than undisturbed boxes. The avoidance of disturbed nesting areas is not surprising given that the presence of humans has been found to deter birds or reduce breeding success in other penguin species Gilling et al. (2008).

Given that the population at Manly has been monitored since the late 1990s the population is likely to have become accustomed to the amount of handling they experience. The uptake of nesting boxes in the population compared to natural burrows has not been assessed.

6.1.4 Current monitoring program

A portion of the known little penguin nesting area in the Manly is monitored regularly during the breeding season by NPWS. Breeding is monitored in the areas of previously known penguin nests in the AOBV Area A and Area B (shown in Figure 6-2) and include:

- + AOBV Area A
 - Quarantine Station
 - Store Beach
 - Collins Beach and AIPM (together are referred to as the Collins Flat site)
- + AOBV Area B
 - Oyama Avenue
 - Addison Road

Nests and potential sites at Little Manly Beach are also monitored although to maintain consistency within data, these nests are not included in the monitoring totals.

Breeding south of Cannae Point⁷, or at sites where access to burrows on private property would invade people's privacy () are not monitored. It is probable that there are also additional nests undetected within the monitored localities, and some known nests are inaccessible hence can't be adequately monitored.

Those nests which can be regularly monitored are considered to provide a representative sample of the total Manly penguin population. The same nests are monitored each year to maintain consistency in the sampling data collected each breeding season. The proportion of all Manly penguin burrows generally monitored as part of this program is thought to be close to 75%.

Results from the 2023-2024 season (monitoring from July 2023 until January 2024) were as follows:

⁷ A penguin was heard calling from the Cannae Point area by NPWS staff during a night survey in October 2023

- + 19 x breeding pairs
- + 39 x eggs laid
- + 37 x fledglings
- + 19 x active nests



Figure 6-2. Map of breeding areas (Source: Figure 1 2024 Manly Little Penguin Sustainability Report 12/06/2024)

Results from the 2023-2024 season were lower than the 2022-2023 season but higher to that observed in 2020-2021 and 2021-2022 (as shown in Table 6-1).

There was again no breeding activity detected in the vicinity of the Boilerhouse Restaurant or the area around the AIPM (in Collins Flat). Breeding activity was also not detected at Collins Beach. The absence of breeding at these locations has had a significant impact on the breeding output of the population at Manly.

The population has not recovered from the extensive losses to the breeding population from the fox predation in the 2015 pre-breeding season.

The most recent monitoring report for the 2023-2024 season identifies that there are still far fewer penguins coming ashore to breed than in the years prior to the 2015 fox predation. The level of breeding declined over a number of years after the incursion but over the last few years, numbers appear to have reached a plateau, albeit at a much lower number.

In the years 2006 to 2014, breeding pairs were regularly in the range from 50 to 70 pairs, and active nests from 84 to 107. In the last five years, numbers of breeding pairs have ranged only from the low this year of 19, to 35 pairs.

Table 6-1 shows the number of breeding pairs from data collected between 1998⁸ and the most recent 2023-2024 monitored season. The total number of breeding pairs following the fox predation incident is outlined in red. Figure 6-3 provides a graphical illustration of the total number of breeding pairs in total and for each AOBV area.

Table 6-1. Number of breeding pairs per breeding area and AOBV

Breeding areas	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024
												3	3	6	5	6	7	6	7	6	5	0	0	0	0	0
												13	10	11	11	10	11	6	5	5	3	6	2	3	10	7
							1	0	1	1	1	2	3	4	4	9	11	6	9	7	3	6	5	1	2	2
	12	12	5	9	8	12	14	10	18	11	7	8	9	8	12	11	10	2	3	5	3	4	2	2	3	0
AOBV Area A	21	17	13	20	22	21	25	18	30	26	31	26	25	29	32	36	39	20	24	23	14	16	9	6	15	9
	17	30	29	15	17	13	16	13	16	20	20	21	13	11	15	19	17	9	7	7	5	6	3	4	3	2
	22	3	3	24	16	15	15	15	18	14	18	19	14	10	10	15	11	11	10	10	9	13	11	11	11	8
AOBV Area B	39	33	32	39	33	28	31	28	34	34	38	40	27	21	25	34	28	20	17	17	14	19	14	15	14	10
	60	50	45	59	55	49	56	46	64	60	69	66	52	50	57	70	67	40	41	40	28	35	23	21	29	19

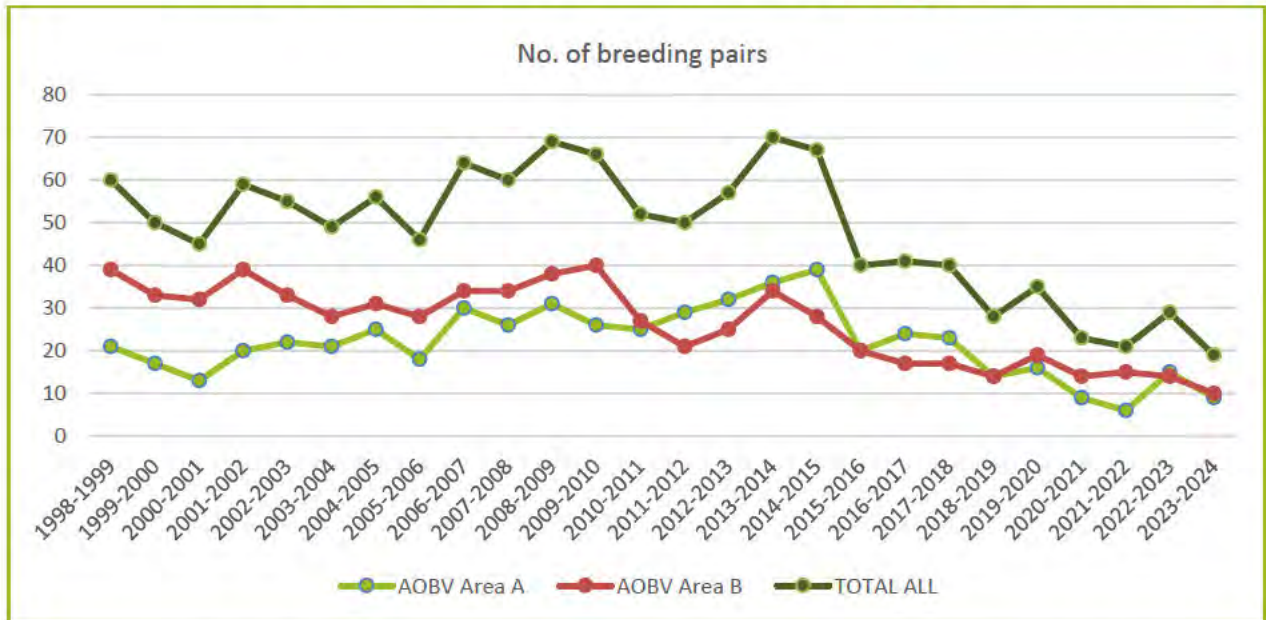


Figure 6-3. Number of breeding pairs per AOBV

⁸ While monitoring data has been collected since the 1998/99 breeding season, the 1998/99 to 2001/02 breeding season data is not directly comparable with data collected since 2002/03 due to a different survey method being used.

Table 6-2 provides a breakdown of the breeding areas known from the Boilerhouse & beach location and the headland [REDACTED] (Store Point but more recently referenced as Rance Point).

Table 6-2. Summary of breeding results from 2009 – 2024 in the Quarantine monitoring area

Breeding area	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024
Boilerhouse & beach	3	3	6	5	6	7	6	7	6	5	0	0	0	0	0
Headland (Store Point)	13	10	11	11	10	11	6	5	5	3	6	2	3	10	7
TOTAL	16	13	17	16	16	18	12	12	11	8	6	2	3	10	7

Figure 6-4 and Figure 6-5 illustrate the breeding pair numbers as broken down in Table 6-2. The red line in Figure 6-4 denotes when ambient music was approved for the outdoor eating area at the Boilerhouse restaurant.

Both Figure 6-4 and Figure 6-5 show that breeding pairs were not detected at the Boilerhouse and QS Beach location during the 2019-2020 breeding season and have not been detected since.

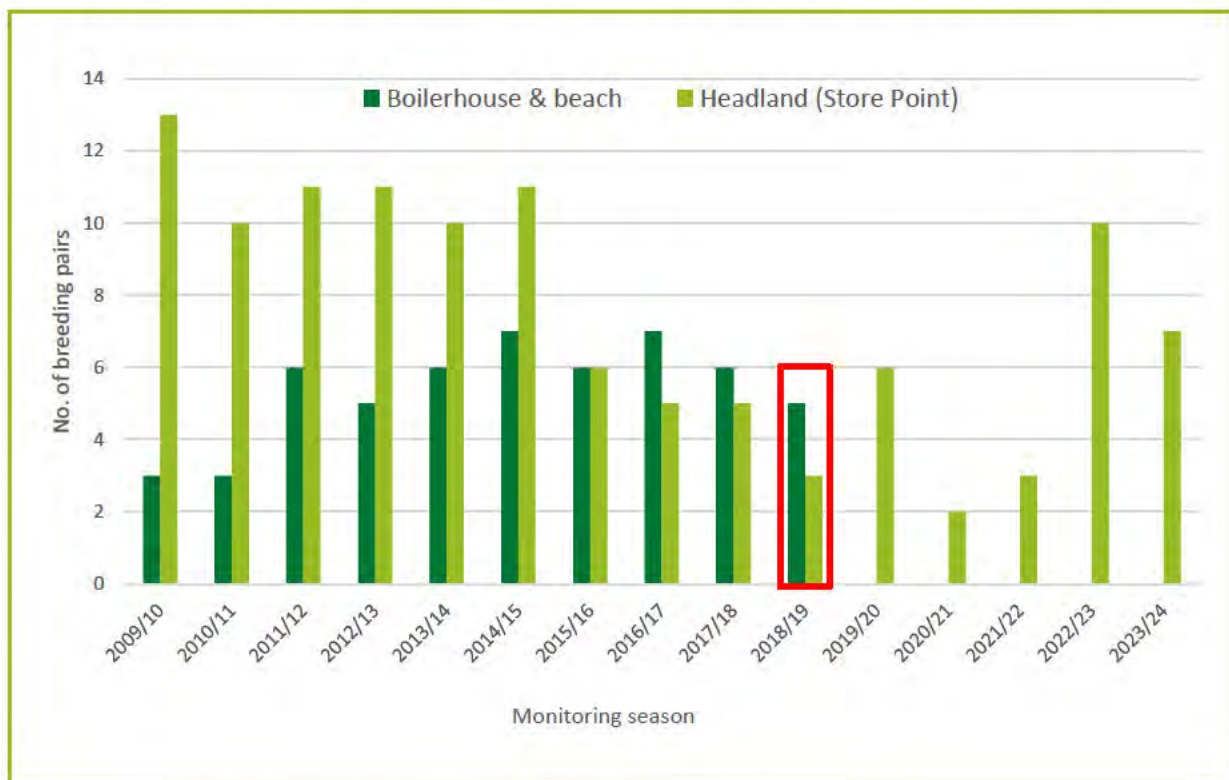


Figure 6-4. Summary of breeding results from Quarantine monitoring area 2009-2024



Figure 6-5. Summary of breeding results from Quarantine monitoring area 2009-2024

The following discussion is also sourced from the latest 2023-2024 monitoring report:

It is considered likely now that the roughly 20 to 30 breeding pairs experienced over the last few years are the new normal base.

Growth is hopefully starting to occur again, but as seen in the past, this is likely to be slow from this low base.

It is possible that the population has dropped to an unsustainable level, and monitoring over the next few years will be crucial to observe which way the population trends.

As for most small populations, the survival of the Manly penguin population will now be even more susceptible to external impacts.

Management options to boost the local penguin population should be discussed, along with other management actions.


Translocations from other breeding sites may be an option in the future.

6.1.5 Relevant conditions

Conditions relevant to the little penguin population and its habitat are listed in Table 6-3 below. Where the status is notated with 'recommendation', further discussion is provided in Section 6.1.7.

Table 6-3. Conditions of existing approval relevant to the little penguin population

Condition	Status
<p>43 A separate application and approval under Part 5 of the EP&A Act, and other relevant legislation, will be required for the provision of independent access to Store Beach, or any works associated with the upgrading of the existing access track or construction of any new tracks to Store Beach.</p>	<p>Although these works are not proposed as part of this REF, this condition is being retained to reflect future approvals pathway for these works.</p> <p>A Species Impact Statement would be required to assess the potential impacts of pedestrian access to Store Beach, which is currently only accessible by water.</p>
<p>112 Outdoor visitor infrastructure</p> <p>(a) the proposed location, design and materials of the external lighting system, to include any emergency lighting. Lighting should have regard to the following principles:</p> <ul style="list-style-type: none"> + the avoidance of light spill in areas of high-use Long nosed Bandicoot foraging habitat and little penguin habitat + the use of lights in the red-orange spectral range in the Wharf Precinct + minimising light spill across the site and outside of the site 	<p>Recommendation:</p> <p>The Outdoor Visitor Infrastructure Plan was incorporated into the Infrastructure Control Plan – Part 1 which was approved by the DECC on 5 November 2008.</p> <p>It is recommended that this plan be reviewed and where applicable revised with consideration to the National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds January 2020 Version 1.0 (see Section 6.1.7).</p>
<p>114 The use of laser or neon lighting (with the exception of emergency lighting), food or beverage vending machines, and commercial advertising signage on the site is not permitted</p>	<p>Ongoing</p>
<p>128 Any special events or functions held after sunset shall:</p> <ul style="list-style-type: none"> + if they are to be held in the Wharf Precinct, must be held indoors. This does not preclude normal operations undertaken as part of the restaurant in building A6, including the outdoor eating area. 	<p>Ongoing</p>

Condition	Status
<p>161 The proposed design and location of any artificial nesting sites or boxes (including for little penguins) are to be endorsed by the DEC. Nest boxes are to be designed to limit the potential for use by possums.</p>	<p>Nest boxes for the little penguin have not been used at the subject site since 2018 (pers. comm. Erica McMahon 2024).</p>
<p>174 Prior to the opening of the restaurant in Building A6 for public use or the commencement of ferry services to the site (whichever comes first), and following approval of the detailed designs by the DEC, permanent barrier fencing (that maintains access for penguins) shall be provided to actively discourage human access to Little Penguin habitat at:</p> <ul style="list-style-type: none"> + the northern end of QS Beach, in the vicinity of the mean highwater mark. The fence shall include signage to indicate that no access along the rocky foreshores is permitted. + the southern end of the QS Beach, in the vicinity of the cliff-line and water’s edge adjacent to the concrete slipway (W1/A13a). The fence shall include signage to indicate that no access along the rocky foreshores is permitted; and + at least 1.5 metres from the western edge of the existing drain adjacent to Building A6 (i.e. towards the building). Consideration shall be given to the use of dense plantings, rather than a fence made of timber or other materials, in the design of the barrier 	<p>Condition fulfilled – no longer relevant.</p> <p>Fencing to south of wharf (Cannae Point in background)</p>  <p>Fencing and signage is provided at the entrance to QS Beach and at the western edge of the drainage pathway next to and alongside building A6.</p> <p>During site inspections Australian brush-turkey (<i>Alectura lathami</i>) nesting activities were evident, which are potentially impacting on fencing and drainage. It is also possible that the large volume of leaf litter and fencing could be diminishing habitat values for the little penguin (see photo plates at the end of this table).</p> <p>Recommendation: habitat enhancement be undertaken (refer Section 6.1.7)</p>

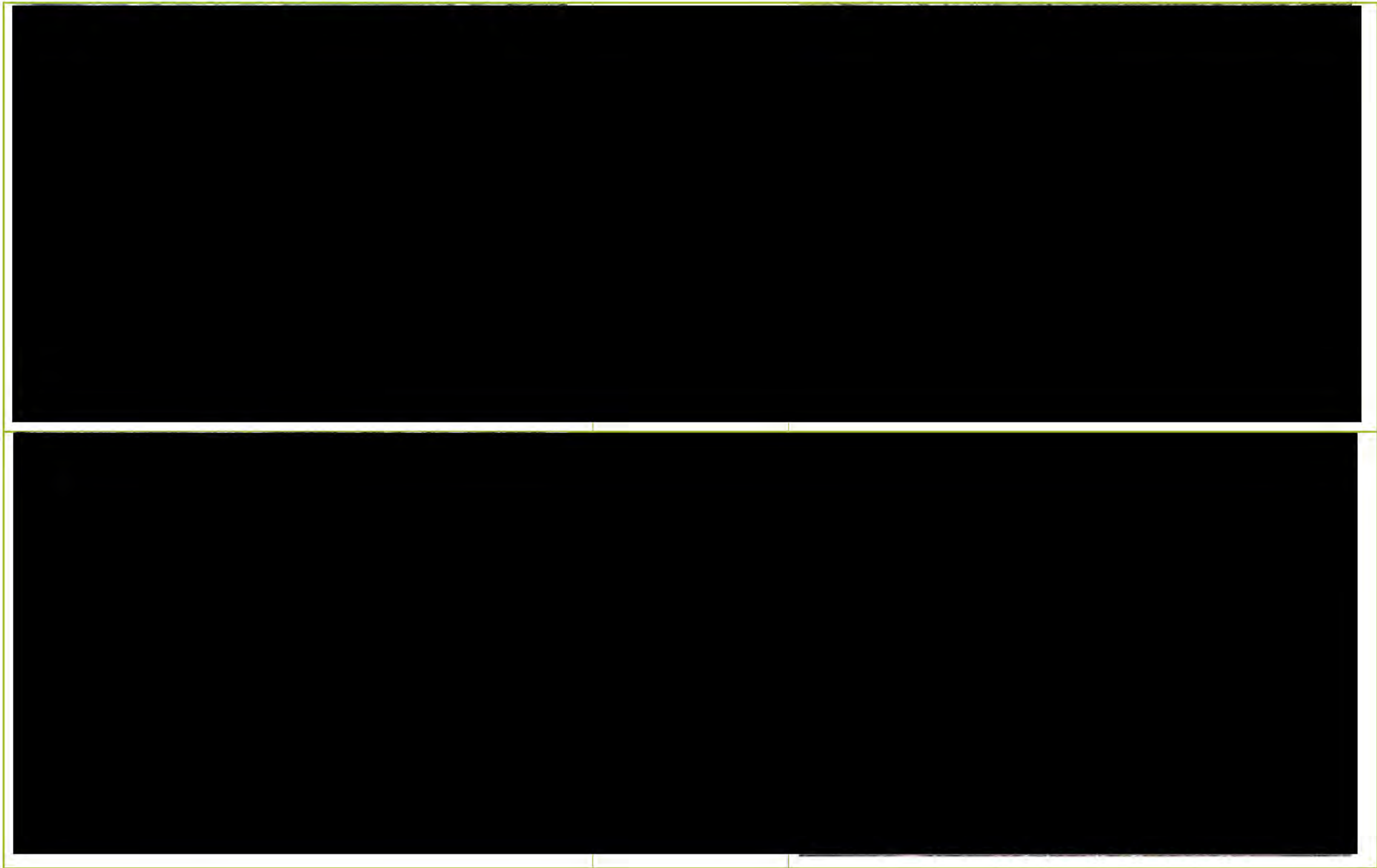
Condition	Status
<p>175 Between sunset and sunrise in the breeding season (July to February inclusive) temporary moveable signage, with appropriate temporary lighting, if necessary, shall be provided on QS Beach. The signs are to be located on the beach above the mean highwater mark in the approximate vicinity of the intersection of buildings A6 and A7. The signs are to advise visitors that access beyond the signs to the northern part of the beach is not permitted, to minimise potential impacts on wildlife</p>	<p>Ongoing requirement Access to QS Beach is prevented by locked gates and fencing between sunset and sunrise and signage is provided.</p>
<p>176 No spotlighting for little penguins is to occur from the ferry or from within the site, unless it is being undertaken as part of an approved special interest tour.</p>	<p>Ongoing requirement</p>
<p>177 Monitoring - the co-proponents will negotiate with the DEC an annual contribution to assist the on-going implementation of any monitoring programs established as part of the Little Penguin Recovery Plan. The contribution will be adjusted annually to reflect changes in the CPI.</p>	<p>Ongoing requirement</p>
<p>178 If any monitoring program under the Little Penguin Recovery Plan ceases to operate during the life of the approval, the co-proponents shall be responsible for developing, implementing and funding a monitoring program that specifically monitors the potential impacts generated by activities within the site.</p>	<p>Ongoing requirement</p>
<p>179 Adaptive management: The co-proponents shall comply with the adaptive management measures detailed in Schedule 8. SCHEDULE 8 - Little Penguins: Adaptive Management Trigger 1 1) If monitoring indicates that the number of active Little Penguin breeding burrows between Cannae Point and the southern end of Store Beach has significantly decreased over two successive breeding seasons (July to February inclusive), and the DEC is satisfied that such decreases are either fully or partially related to the activity, the DEC may direct the co-proponents to implement appropriate measures. The measures may include, but not be limited to:</p>	<p>Ongoing requirement Refer to condition 181.</p>

Condition	Status
<ul style="list-style-type: none"> + a reduction in the number of lights and their intensity in the Wharf Precinct, particularly in the vicinity of the restaurant in A6; + the provision of acoustic barriers in the vicinity of the restaurant at night, especially the outdoor eating area; + cessation of outdoor dining in the vicinity of the restaurant in A6 at night during the breeding season (or all year round); + restrictions on ferry movements, such as a set period either side of sunset or no movements between sunset and sunrise; and + the provision of alternative public transport to the site during times when ferry movements are restricted. <p>If further on-going monitoring indicates that the number of active Little Penguin breeding burrows in this area continues to decrease over subsequent breeding seasons, the DEC may direct the co-proponents to implement further measures.</p> <p>2) The co-proponents shall comply with any directions issued by the DEC in accordance with clause 1. Any measures required to be implemented may be reversed or altered with the approval of the DEC if monitoring indicates that the number of active Little Penguin breeding burrows for the population has increased over two successive breeding seasons.</p> <p>3) If Little Penguin deaths occur in the vicinity of the site as a result of matters reasonably beyond the control of the co-proponents (such as predator attacks, oil spills, etc.), the number of active breeding burrows considered for the purposes of clause 1 may be adjusted in consultation with the DEC to account for such impacts (e.g. to account for the likely impact of predator related deaths on lowering the number of active burrows).</p> <p>Trigger 2 – potentially catastrophic events</p> <p>1) If information becomes available that indicates a significant reduction in the size of the Little Penguin population or a significant change to the behaviour of the population within a period of less than two successive</p>	

Condition	Status
<p>breeding seasons, and the DEC is satisfied that the activity is likely to have contributed to that decline or change, the DEC may direct the co-proponents to implement appropriate measures. These may include, but are not limited to, the measures specified in Trigger 1.</p> <p>2) The co-proponents shall comply with any directions issued by the DEC under clause 1. Any measures required to be implemented may be reversed or altered with the approval of the DEC.</p>	
<p>180 Future measures:</p> <p>The co-proponents will provide funding to the OEH to undertake a review of the long-term monitoring data and to provide recommendations on the long-term sustainability targets for the Manly Little Penguin population every five years from the determination date of Modification 3.</p>	<p>MOD 3 was approved on 25 May 2018.</p> <p>NPWS commissioned a review of the long-term monitoring data and long-term sustainability targets for the little penguin population, which was completed in June 2024 by Dr Lisa O’Neill.</p>
<p>181 Based on the revised monitoring and long-term sustainability targets (Term 180) and following consultation with NPWS regarding the Little Penguin population, the Minister for the Environment may recommend to the Secretary that the trigger thresholds and/or adaptive management measures be revised. Prior to the Minister for Planning agreeing to any significant revised measures, the details of the proposal and the 5year report are to be made available for public comment and consideration</p>	<p>Recommendation: O’Neill (2024) has recommended amendments to the CoPA triggers that would activate adaptive management as per Condition 179.</p> <p>There is presently insufficient data to determine the feasibility of the amendments recommended. Refer to Section 6.1.7.3 for further detail.</p>
<p>182 The co-proponents shall ensure that the undertaking of the activity complies with any revised measures specified in condition 181).</p>	<p>Refer to Section 6.1.7.3 for further detail.</p>
<p>201 Amplified music or noise on the site shall be managed on the following basis:</p> <p>(a) any amplified music or noise or ambient dining music shall not exceed the LAeq noise level of 50 dB(A) as measured up to 20 metres away from the edge of the building in which the music or noise is being generated;</p> <p>(b) outdoor amplification may only occur during the day period and must not exceed LAeq noise level of 50 dB(A), as measured at any point along the existing fence line (as at 2017) to the beach area; and</p>	<p>These conditions aim to protect the nearby little penguin habitat.</p> <p>Recommendation: Additional noise monitoring and sound reduction measures are recommended in Section 6.1.7 to fill existing knowledge gaps and provide additional protection to little penguin habitat</p>

Condition	Status
<p>(c) ambient dining music in the outdoor eating area adjacent to the Boilerhouse Restaurant (Building A6) during the evening and night time period is restricted to the following times:</p> <ul style="list-style-type: none"> i. March to April (inclusive): no restriction; ii. May to July (inclusive): not permitted at any time; and iii. August to February (inclusive) not permitted from sunset. 	





6.1.6 Impact assessment

The continuing poor results overall show that the little penguin breeding population has reduced considerably at Manly. The population has not been able to recover from the extensive losses to the breeding population from the fox predation in the pre-breeding season of June 2015.

The current low level of the population means there is little buffer against other impacts such as changes in oceanic conditions, which could affect individual breeding seasons or the long-term population. The current low level of the population can especially not withstand another catastrophic predation event such as the fox predation in 2015.

Past reporting has not indicated that Q Station’s operation as a causal factor in the little penguin’s breeding population decline, despite the absence of breeding proximal to the QS Beach and Boilerhouse Restaurant.

However, it is not clear why the CoPA Trigger 1 was not triggered following the results for the 2020/21 to 2021/22 seasons (i.e., two successive years of a significant decrease in active breeding burrows at the Quarantine location). The most likely explanations would include either:

- + NPWS were not satisfied that the decreases were either fully or partially related to the facility’s operation, or
- + There was some additional buffer provided due to the population still being in recovery from the fox predation in 2015.

Table 6-4 shows the number of active nests at each locality since the 2006/07 season with results from the 2020/21 to 2021/22 seasons outlined in red. Similar decreases in the number of active nests at other localities are outlined in yellow.

Table 6-4. Number of active nests sites at each locality

	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
	18	22	25	23	23	19	22	23	26	17	15	14	14	8	3	3	10	7
	2	4	6	3	4	4	6	11	14	10	13	10	7	6	5	1	2	2
	23	19	15	12	13	16	12	14	18	8	4	5	6	5	2	2	3	0
	20	30	27	33	20	27	28	22	28	19	12	11	12	7	6	5	3	2
	21	23	28	25	22	20	19	18	21	14	13	15	16	18	13	11	11	8
Total	84	98	101	96	82	86	87	88	107	68	57	55	55	44	29	22	29	19

Note: Separation of data collected from the QS Beach / Boilerhouse location from Store Point was only provided for the number of breeding pairs and not for the number of active nests. However, as shown in Table 6-5 there is little to no variation in data from the 2019/20 season onwards and therefore using the breeding pair data remains valid.

Table 6-5. Number of breeding pairs compared to active nest sites at QS Beach / Boilerhouse and Store Point

Parameter	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Breeding pairs															
Boilerhouse & beach	3	3	6	5	6	7	6	7	6	5	0	0	0	0	0
Headland (Store Point)	13	10	11	11	10	11	6	5	5	3	6	2	3	10	7
Total	16	13	17	16	16	18	12	12	11	8	6	2	3	10	7
Active nests															
Boilerhouse/beach & Store Point total	23	23	19	22	23	26	17	15	14	14	8	3	3	10	7

If the existing trigger calculations were limited to active nests or breeding pair data from QS Beach and Boilerhouse only, CoPA Trigger 1 may have been exceeded following the results collected from the 2020-2021 season (providing DCCEEW were satisfied that the trigger was either fully or partially related to the operation of the facility).

O'Neill (2024) identifies a decrease in 2018 and complete cessation of breeding in following years at the QS Beach / Boilerhouse location and further identifies this coinciding with approval to allow amplified music in 2018.

O'Neill (2024) considers that the breeding numbers had been reasonably consistent over the previous eight years, even with the fox incursion and suggest other factors contributed to the sudden decline. While the decline cannot be specifically attributed to the QS Beach / Boilerhouse Restaurant operation, O'Neill (2024) considers that ongoing disturbance from human activities in this area is likely to have influenced the decline.

While this is a reasonable hypothesis it cannot be tested due to a lack of 'before impact' data and ongoing data collection from all sites and appropriately located control and reference sites.

Figure 6-6 illustrates the variability between sites and within the wider AOBV Area A for breeding pair data. Store Point is the only site that doesn't exhibit some recovery immediately following fox predation in 2015 but is the only site not following the decreasing trend in breeding pairs from 2018-2019.



Figure 6-6. No. of breeding pairs at localities with AOBV Area A

O'Neill (2024) also discusses the potential cause for the lack of recruitment at QS Beach and Boilerhouse area to be due to the following aspects:

- + The incumbent breeding penguins were most likely accustomed (habituated) to the human activities at the site
- + Attrition of the locality's breeding penguins over time (i.e., retirement from breeding and death)
- + Potential new breeding recruits not habituated to human activities and scared off by human activity when prospecting at the site
- + The availability of higher quality nesting habitat elsewhere in Spring Cove (given the numbers of penguins previously breeding in the Manly area, there is extensive habitat available elsewhere that does not carry the burden of this level of extra human disturbance)

The last point raises three important considerations.

1. Nesting habitat availability

A lack of available nesting habitat is often reported as a limiting factor to little penguin population growth. Whereas the reverse appears to be the case for the population at Manly.

The highest number of active nests reported since monitoring began at Manly is 107 from the 2014-2015 season. In comparison, only 19 active nests were reported in the 2023-2024 monitoring report.

Therefore, it is not unreasonable to believe that there is likely to be an abundance of available nest habitat for prospecting penguins.

2. Lack of recruitment

No Manly penguin fledglings were encountered returning to the colony to breed in the past 2023-2024 season and in only one of the last three seasons, has a previous fledgling been discovered breeding at Manly. A total of 54 fledglings have returned to Manly since 2000, 39 of which have bred, some of them over a number of seasons (NPWS, 2024).

3. Fidelity

Little penguins are philopatric, a term that literally means “love of one’s home” and in biology describes a process in which an animal returns to its place of birth or hatching to reproduce. In the language of biology, little penguins possess a strong “site fidelity” (Thom van Dooren, 2014).

The strength of the little penguin’s site fidelity is exemplified in the Manly population when obstacles were built in the way of breeding habitat at Manly Point. Locals reported penguins coming ashore farther along the coast, making their way across a small beach, up a flight of stairs, along the street, down another flight of stairs, and under the house that they had been so unceremoniously evicted from (NPWS 2000).

In combination the species’ strong fidelity to a site and abundance of vacant nesting habitat does suggest that the past generations of breeding penguins are in fact too old to breed or are deceased.

In the absence of recruitment, the high rate of nesting vacancies in Spring Cove is likely to continue into the future without intervention to enhance the population size.

A range of additional monitoring and mitigation measures are recommended in Section 6.1.7 to ensure a better understanding of disturbance impacts and provide additional protection for the little penguin habitat adjacent to the Boilerhouse Restaurant.

6.1.7 Mitigation measures

6.1.7.1 Monitoring and data management

As is evidenced in the preceding sections, there are a number of data deficient areas from which potential or suspected threats cannot be conclusively linked to impacts on the little penguin in the study area. Instead, we are reliant on anecdotal or qualitative observations, and scientific research that is largely generated from interstate populations.

Filling the existing knowledge gaps with site-specific data collection will enable a more informed approach to managing little penguin habitat areas within the QS lease area and elsewhere in the AOBV areas.

It is recommended that additional data be collected as follows:

- + Expand monitoring to include recommendations made by O’Neill (2024), which include:
 - A monthly assessment of accessible nests and habitat on Cannae Point, and
 - Remote camera monitoring of QS Beach as recommended by O’Neill (2024).

Alternatively, or in addition to camera traps, consider the acoustic monitoring and analysis (e.g. songmeter/kaleidoscope or similar).

- + Noise levels within and outside of Q Station so that background noise levels and potential external noise pollution impacts on the little penguin can be discerned and noise management more accurately guided
- + Data relevant to climatic variability for comparison against little penguin monitoring parameters, which might include:
 - o Ocean Sea Surface Temperatures (SST) - weekly data is available since January 2010 onwards from the Bureau of Meteorology
 - o SST anomaly mapping that displays the degree difference from normal conditions (available
 - o Water quality data: as available from other sources including the Australian Ocean Data Network (AODN), Sydney Institute of Marine Science (SIMS) and tertiary institutions.

Additional recommendations include the following:

- + Data management:
 - o NPWS database be improved and updated on an annual basis to enable access to monitoring parameters whenever required.
 - o This should include an inventory of known nests/burrows including relevant locational code and GIS data, type and condition, and whether used or not (this may be limited to location for natural nests, understanding not all can be visually assessed).

Note: Inefficiencies in obtaining data became evident during preparation of this SIS and, despite NPWS staff’s efforts, some data were unable to be provided.
- + Compliance: Inclusion of a compliance checklist against consent conditions in monitoring reports (i.e. identifying whether thresholds have been triggered).
- + Incorporate a nest activity threshold like Trigger 1 of QS CoPA 179 across all localities within the AOBV areas. This would provide more site-specific performance targets than that provided in the recovery plan.

6.1.7.2 Mitigation measures

Mitigation measures shall continue as per existing consent conditions.

A range of additional measures are recommended in Table 6-6, which should be considered and undertaken in consultation with relevant discipline specialists (i.e., penguin biology/ecology, acoustics, landscaping/bush regeneration).

Table 6-6. Little penguin recommended management and mitigation measures

Recommended measure	Rationale
Monitoring program	
Supplement the monitoring program as recommended in Section 6.1.7.1	As per Section 6.1.7.1
Lighting	
Review lighting within the Wharf Precinct to assess existing design parameters against current guidelines, standards and best practices, including:	Ensure mitigation of light spill impacts are updated to use the most recent advancements and guidelines

Recommended measure	Rationale
<ul style="list-style-type: none"> + National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds January 2020 Version 1.0. + International Dark-Sky and Australasian Dark Sky practices (https://www.australasiandarkskyalliance.org/best-practice-lighting). 	
Acoustic	
<p>Installation of acoustic barriers to reduce noise to habitat areas and beach adjacent to the Boilerhouse Restaurant.</p> <p>Noting that opaque noise barriers such as glass or perspex can be used to maintain water views to the beach.</p>	<p>Draft SIS feedback provided by NPWS required that ‘suspected’ threats on an AOBV, and in turn the little penguin population, be treated as an actual threat.</p> <p>Hence, despite the lack of certainty regarding causal factors (for the cessation in use of the QS Beach / Boilerhouse habitat), immediate measures to reduce potential noise impacts on the species habitat are recommended.</p> <p>Note: the provision of acoustic barriers in the vicinity of the restaurant at night, especially the outdoor eating area is an adaptive measure that identified in CoPA no. 179 (Adaptive Management).</p>
Habitat enhancement	
<p>In consultation with the NPWS little penguin recovery team, determine the most appropriate landscaping, artificial habitat creation and maintenance requirements that can be implemented at the QS Beach location adjacent the Boilerhouse Restaurant.</p>	<p>As shown in photographic plates (at the end of Section 6.1.5), there are several landscaping issues that could be mitigated to provide a beneficial outcome (with regards to little penguin habitat).</p>

6.1.7.3 CoPA amendments

Trigger 1: the threshold to activate CoPA 179 Trigger 1 is currently based on a significant decrease over two successive breeding seasons in the number of active breeding burrows between Cannae Point and the southern end of Store Beach.

O’Neill recommended that the *“the penguin data used in the Trigger determination be restricted to breeding in the areas of the QS lease which are subject to human disturbance - Quarantine beach and the boilerhouse area”* (Page 13 of the Manly Little Penguin Sustainability Report dated 12/06/2024).

As there is currently no breeding detected, a trigger threshold of zero is not feasible.

During consultation with NPWS, it was later confirmed that O’Neill intended her recommendation be that stated on page 14 of the sustainability report which states.

“Modify penguin numbers used in the CoPA trigger to be those specifically in the immediate area of the old QS Boilerhouse and Quarantine beach”.

The rationale for this modification is as follows:

“If activities in the QS lease area are those being considered in the CoPA, it makes sense that the QS lease is the area in which penguin numbers are counted toward that trigger. The existing trigger calculation includes both birds using the QS lease area and Rance Point. Most of the penguins breeding toward the end of Rance Point are outside the QS lease, yet they are currently counted toward the penguin numbers used in the trigger calculation. I would recommend the penguin data used in the Trigger determination be restricted to breeding in the areas of the QS lease which are subject to human disturbance - QS Beach and the Boilerhouse area.”

The intent of the modification to separate localities based on environmental variability is logical. However, data relating to penguin numbers at any locality is not currently reported and it is not clear whether such data exists.

To support the modification of a legally binding consent condition, a scientifically robust baseline is required.

New Trigger: O’Neill (2024) recommends a new trigger that activates the immediate reduction in human disturbance, particularly sound and light, for a period of some months if penguins are detected in the QS Beach and the Boilerhouse area, whether through the monitoring program or recommended wildlife camera installation in key areas (see Section 6.1.7.1 and page 13 of the Manly Little Penguin Sustainability Report dated 12/06/2024).

The rationale for this new trigger is as follows:

“While penguins can habituate to some disturbance, new breeders are more likely to return to a less disturbed area. If penguins are detected, then an immediate reduction in human disturbance has been recommended in the hope that prospecting penguins may choose to resettle in the area.”

For the same reasons provide above for the recommended modification of Trigger 1, the new trigger proposed by O’Neill (2024) is not supported.

Additionally, the potential for penguins to come ashore at QS Beach may not necessarily relate to prospecting activities (i.e. escaping from a marine predator, avoiding boat activity closer to other preferred landing areas, tiredness, illness).

Further issues with the recommended new trigger include:

- + The time between detection and responding operational intervention is unlikely to be efficient enough to increase the opportunity of habitat take up by prospective penguins (if human activity was the deterrent)
- + The proposed immediate reduction in human disturbance is not feasible for various operational reasons (i.e. managing bookings / cancellations and in turn impact on employee income, food spoilage, reduction in available venues for hotel guests and daily visitors).

Due to the range of uncertainties that require further monitoring to address, installation of noise reduction measures is recommended (refer to Section 6.1.7.2). This is an existing adaptive management response required in the event that the existing Trigger 1’s threshold is exceeded.

6.2 Long-nosed bandicoot (*Perameles nasuta*)

6.2.1 General description

The long-nosed bandicoot is a medium-sized, ground-dwelling marsupial. Adults usually weigh approximately 750–1100 g, however, can range from 450–2050g, with a head body length of 310–445 mm and a tail length of 120–160 mm (DAWE, 2021).

Long-nosed bandicoots live in forests and woodlands, and heath and are found in eastern Australia, from Queensland, New South Wales and Victoria. They were once widespread and common in Sydney. Today their range and distribution in the Sydney region is reduced and isolated populations remain in bush land areas to the north and south of Sydney. A small colony at North Head, Manly is classified as an 'endangered population'. A Recovery Plan has been made but is still in draft form (DAWE, 2021).

They are omnivorous, feeding on a variety of hypogeous fungi, soil invertebrates and plant roots but the species is primarily insectivorous year-round.

Essentially a solitary animal that occupies a variety of habitats on North Head, foraging mainly at or after dusk, digging for invertebrates, fungi and tubers. The conical holes it leaves in the soil are often seen at the interface of naturally vegetated and areas of open grass around Q Station, former Defence Lands and Saint Patrick's Estate.

The species shelters during the day in a well-concealed nest based on a shallow hole lined with leaves and grass, sometimes under debris, sometimes hidden with soil and with the entrance closed for greater concealment.

Relevant habitat and resources for long-nosed bandicoots within the subject site include:

- + Stands of dense shrub vegetation (including areas of dense weed infestation) which provide shelter and nest sites. There are substantial patches of vegetation throughout the subject site, and extensive tracts of mostly native vegetation around the site, which provide suitable potential shelter and nesting habitat for the species.
- + Extensive areas of foraging habitat, particularly including mown lawns with areas of moist and apparently deep soils. Whilst the species will forage broadly throughout the grassed portions of the subject site and within the shrub and woodland habitats, areas of mown grass which display higher moisture levels and apparently high productivity appear to be favoured.

6.2.2 Conservation status

The North Head population of the long-nosed bandicoot is listed as an "endangered population" under Part 2 of Schedule 1 of the BC Act .

In regional terms, the long-nosed bandicoot is regarded as common to abundant within suitable habitat. However, in terms of the North Head population of the long-nosed bandicoot, it is now isolated and disjunct.

However, in terms of the North Head population of the Long-nosed Bandicoot, the "regional" abundance of the species is of no relevance, because there is no possibility of connection between the North Head population and other populations. The conservation status of the Long-nosed Bandicoot in the Sydney Basin region is not of concern on a state-wide basis. Whilst this species is common and widespread in the Sydney Basin region and its conservation status in a regional context is not of concern, many populations of the Long-nosed Bandicoot in the Sydney district have become extinct (NSW Scientific Committee, Final Determination). In terms of the "local conservation status" of the Long-nosed Bandicoot population on North Head, the NSW Scientific Committee is of the opinion that "its numbers have been reduced to such a critical level, or its habitat has been so drastically reduced, that it is in immediate danger of extinction".

Population genetic theory would suggest that a population as small as that of the North Head *P. nasuta* population would suffer effects of inbreeding depression and loss of genetic variation, affecting population viability. In addition to genetic consequences of small population size, a small population occupying a limited, discrete area is at risk from stochastic disturbance events (NSW Scientific Committee, 1997).

At the time of its listing as endangered, the population at North Head was estimated to be about one hundred animals, with fluctuations around this number over time.

6.2.3 Threats

Threats to the population at North Head listed in the TBDC, and the threat relevance is outlined below.

Habitat loss and fragmentation because of urban development.	Threat is not present in QS lease area and wider North Head area – no further development is anticipated.
Predation by domestic cats and dogs significantly impacts the viability of the population.	Managed by NPWS in accordance with the North Head QS Predator & Pest Control Plan (2008)
Inbreeding depression due to habitat fragmentation isolating the population.	Potential to occur
Outbreaks of disease (e.g. toxoplasmosis) would contribute to the decline of bandicoots particularly due to the small populations size.	Potential to occur
Inappropriate fire regime	Fire regimes are managed by NPWS
Predation by introduced foxes significantly impacts on the viability of the population.	Managed by NPWS in accordance with the North Head QS Predator & Pest Control Plan (2008)
Road mortality and injury - increased levels of road mortality due to habitat fragmentation and urban development.	Threat is present (refer to Section 6.2.4.2)

6.2.4 Current monitoring program(s)

6.2.4.1 Ecological Health Monitoring Program

The endangered population of Long-nosed Bandicoots (hereafter referred to simply as bandicoots) on North Head has been systematically monitored since 2002 (Price & Banks, 2021). Monitoring and management forms part of the work program of the North Head Long-nosed bandicoot Recovery Team. NPWS and other stakeholders such as Australian Wildlife Conservancy monitor the population cross the headland.

This includes monitoring bandicoot numbers, health, and breeding success and how they are responding to threats, such as habitat loss, predation by dogs and foxes, inbreeding and disease.

Monitoring of the long-nosed bandicoot population on North Head undertaken by the Australian Wildlife Conservancy (AWC) is a component of the Ecological Health Monitoring Program (Ecohealth) for the Harbour Trust, which has been conducted since 2017– and includes the Q Station on behalf of NPWS.

This monitoring program comprises 47 transects with 6 cage traps each for 5 nights repeated annually at the locations shown in Figure 6-7.

Previous monitoring programs reported by Price & Banks (2021) have been undertaken biannually from 2002.

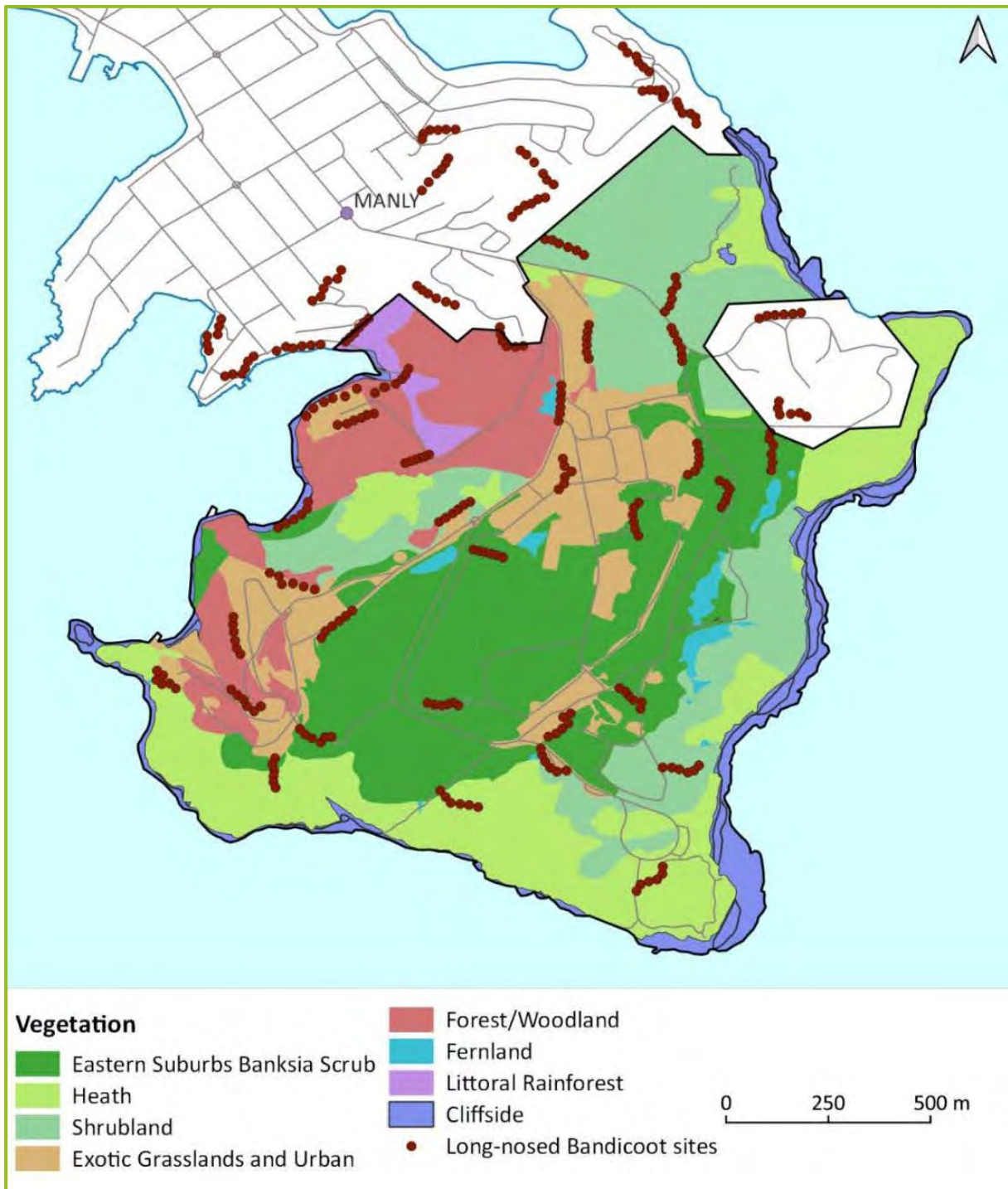


Figure 6-7. Location of bandicoot monitoring sites (from AWC EcoHealth reporting)

In 2022, 123 bandicoots were trapped (captured) a total of 239 times across 47 transects. Population modelling resulted in an estimated population size of 193 (± 17) individuals (see Figure 6-8). This was the second highest population estimate since 2004, lower only than 2021.

Numbers of bandicoots on the headland remain relatively high compared to historical data.

The sex ratio of individuals captured in 2022 was even for the first time since 2016. In 2017-2021 the sex ratio was female biased.

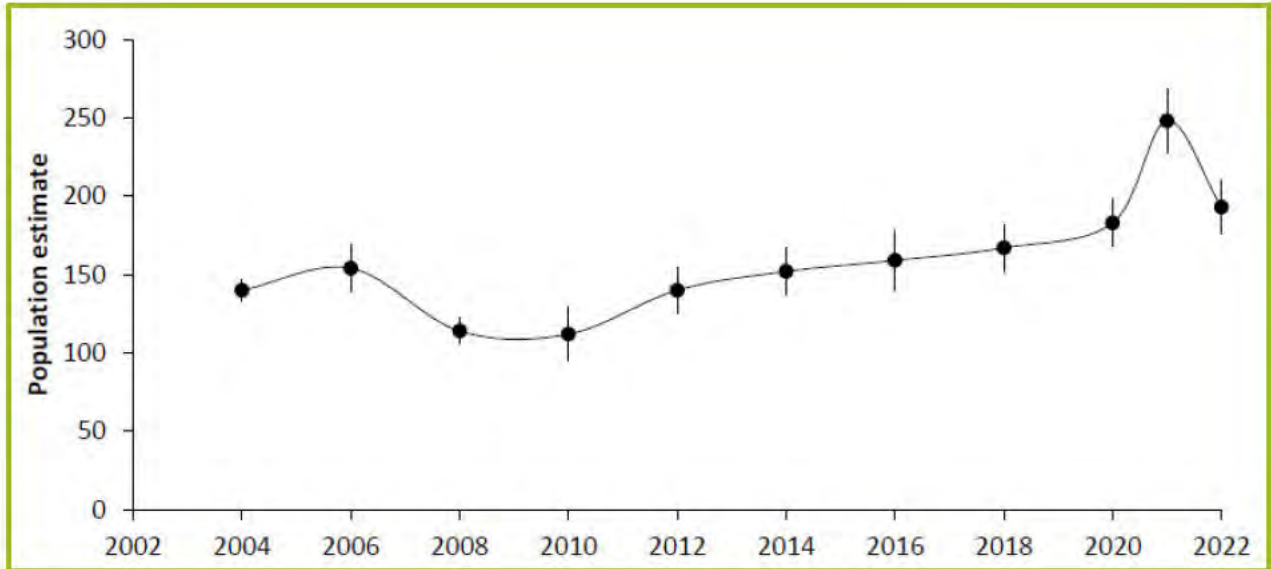


Figure 6-8. Long-nosed bandicoot population estimates (±SE) over time on North Head

Table 6-7 provides a summary of bandicoots trapped (captured) and number of individuals from the North Head headland with Q Station (the subject site) reported separately. Figure 6-9 illustrates the number of individuals from the headland and the subject site from 2017 to 2022.

Table 6-7. Long-nosed bandicoot monitoring 2017- 2023

Location & type	May 2017	May 2018	Nov 2018	May 2020	Nov 2020	May 2021	May 2022	May 2023
QS captured	21	53	8	32	Approx 10	Approx 69	Approx 62	
QS individuals	15	16	5	16	Approx 8	Approx 41	Approx 29	
Whole of headland (North Head) captured	83	265	104	207	Approx 47	Approx 338	257	363
Whole of headland (North Head) individuals	60	114	55	109	29	Approx 107	Approx 80	114

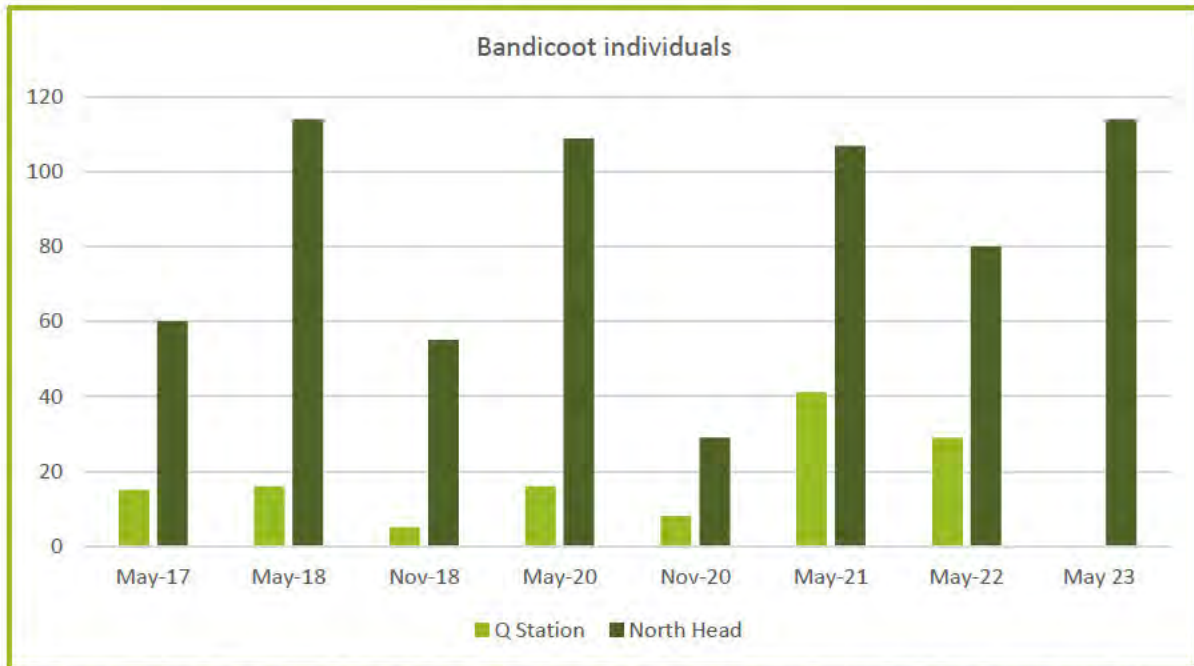


Figure 6-9. Individual bandicoots found during monitoring at Q Station and at North Head headland 2017-2022/23

6.2.4.2 Road mortality monitoring

Long-nosed bandicoot road mortalities have been monitored by way of incidental records, including by the public and register maintained by the AWC and NPWS. Mortalities reported from locations across both NPWS and the Harbour Trust tenure (i.e., across the entire headland) have been as follows:

- + Seven mortalities in 2022 with June and October the highest number of vehicle strike mortalities (n = 2 for each).
- + Six mortalities in 2021 with September the highest number of vehicle strike mortalities (n = 2). The remainder of mortalities (n = 2) occurred in April and August.
- + Seven mortalities in 2020 with March the highest number of vehicle strike mortalities (n = 3). The remainder of mortalities (n = 4) occurred in April, August, November and December.

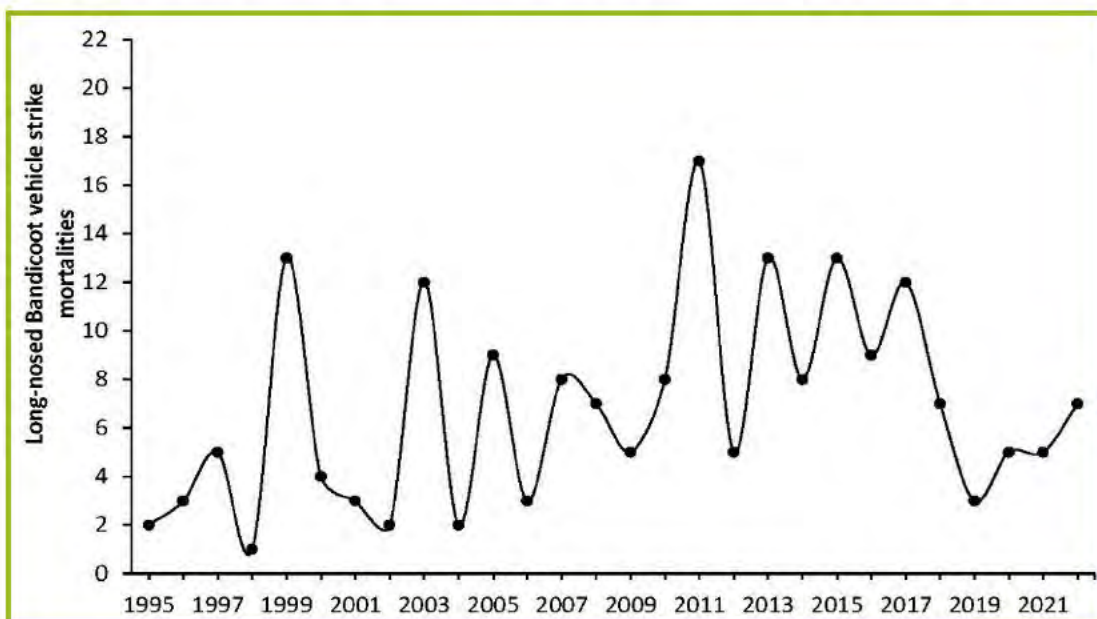


Figure 6-10. Long-nosed bandicoot vehicle strike mortalities on North Head from 1995-2021

In previous years, vehicle strike mortalities have seen a decreasing trend (Figure 6-10) likely due to scheduled park closures and increased signage. In addition to increased greenspace use, the slight increase in 2020 compared to 2019 may be a result of additional traffic associated with the presence of a production crew on the headland.

Figure 6-11 shows



MGA Zone 56 (GDA 2020) | Nearmap 25.02.2024

Figure 6-11. Bandicoot habitat areas

6.2.5 Relevant conditions

Conditions relevant to the long-nosed bandicoot population (bandicoot) are listed in Table 6-8 below.

Table 6-8. Conditions of existing approval relevant to the long-nosed bandicoot population

Condition		Status
164	Grassed areas on the site must be kept in good condition. No fertilisers or chemicals should be applied to open grassed areas, except where this is essential to the repair and stabilisation of existing eroded areas and is consistent with the provisions of the approved Heritage Landscape Master Plan (condition 91).	Ongoing compliance
165	Within 12 months of the commencement date the co-proponents shall undertake further assessments to refine the mapping of high-use bandicoot foraging habitat and to identify suitable potential areas and techniques for habitat enhancement, reconstruction and rehabilitation. The outcomes of the assessment should be informed by the monitoring program specified in Schedule 5 and are to be submitted to the DEC for approval and incorporated into the Heritage Landscape Management Plan (condition 91) prior to any habitat works commencing.	<p>During consultation for the proposal (NPWS consultation - AKA Acoustic May 2024) following recent habitat assessment NPWS understands that the recent habitat assessment found the following:</p> <p><i>Given the spatially and temporally variable nature of LNB foraging, it is impossible to meaningfully differentiate areas of higher quality foraging habitat from other areas, and the whole site should be considered potential high-quality habitat.</i></p> <p>Figure 6-11 shows potential high-use bandicoot foraging habitat mapped by Gunninah (2001), indicative habitat areas mapped by Manidis Roberts (2003) and additional areas mapped by DEC (2005).</p>
166	Any works undertaken for the activity that involve the loss of, or damage to, bandicoot foraging habitat shall be offset by the undertaking of habitat enhancement, reconstruction or rehabilitation works on an area elsewhere at North Head that is at least ten times the size of the area impacted.	No works triggering this requirement reported from 2017-2022.
167	Monitoring	Ongoing compliance

Condition		Status
	The co-proponents shall implement the monitoring program detailed in Schedule 5.	See Table 6-9
168	<p>Adaptive management – foraging habitat</p> <p>If the monitoring of bandicoot activity and use of foraging habitat indicates a statistically significant reduction in bandicoot numbers between the control and non-control areas over two consecutive years, measures will be taken, in consultation with the DEC, to reduce the extent of light, noise and activities at relevant locations. Measures may only be reversed or altered with the approval of the DEC.</p>	Ongoing compliance
169	<p>Adaptive management – road mortalities</p> <p>All adaptive management measures presented within Schedule 6 must be implemented and the co-proponents must contribute to the mitigation of potential impacts on the Long-nosed bandicoot population across North Head. This includes, but is not limited to, participation in the North Head Stakeholder Group, or its successors. The co-proponents will actively promote awareness of the need for bandicoot protection across North Head.</p>	<p>From 2017-2022 Monitoring Report:</p> <p>The number of long-nosed bandicoot adult deaths attributed to vehicles was within the acceptable range for Trigger 2 which is less than 2 adult deaths for any 6-month period.</p> <p>Triggers 3 to 5 relating to this monitoring feature were not triggered during the reporting period.</p> <p>Table 6-9 and Table 6-10 provide detail relating to the monitoring and acceptable range triggers.</p>
169A.	The co-proponents must provide signage at the entrance to Sydney Harbour National Park near Parkhill Archway, to indicate the number of bandicoot road mortalities recorded on North Head. The sign(s) shall include, but not be limited to, a short statement regarding the endangered status of the population, its estimated population size (within North Head), the threat that road deaths pose to its continued survival, the total number of road deaths from the previous year and a running tally of the number of deaths during the current calendar year. The tally shall be updated after each confirmed road death as recorded on the mortality register referred to in Schedule 5. The sign shall also include a 24hour phone number (see also Term 6) to allow members of the public to inform the lessor of any mortalities and what to do if an injured bandicoot is found.	Ongoing compliance
170	All adaptive management measures presented within Schedule 6 must be implemented and the co-proponents must contribute to the mitigation of potential impacts on the bandicoot population across	See Table 6-10

Condition		Status
	North Head. This includes, but is not limited to, participation in the North Head Stakeholder Group, or its successors. The co-proponents will actively promote awareness of the need for bandicoot protection across North Head.	
171	<p>Future measures</p> <p>The Lease shall stipulate requirements regarding the provision of funding to the OEH to undertake a revised population viability assessment (PVA) for the bandicoot every 6 years from the determination date of Modification 3.</p>	<p>The last PVA report was completed in 2020 and an interim PVA will be reviewed in 2024. The PVA reporting periods do not align with those outlined in the CoPA.</p> <p>Analysis relating to reporting years 2017 to 2020 covered in the 2020 PVA found that under current conditions, the North Head population has a 64% chance of persisting after 50 years.</p> <p>NOTE: the 2014 PVA identified a 62% persistence rate.</p>
172	Based on the revised PVA, the provisions of any adopted recovery plan for the Long-nosed Bandicoot population and following consultations with the co-proponents, the Minister for the Environment may recommend to the Minister for Infrastructure, Planning and Natural Resources that the trigger thresholds, background adult road mortality levels and/or adaptive management measures be revised. Prior to the Minister for Infrastructure, Planning and Natural Resources agreeing to any significant revised measures, the details of the proposal and the PVA are to be made available for public comment.	Trigger thresholds are provided in Table 6-10
173	The co-proponents shall ensure that the undertaking of the activity complies with any revised measures specified in condition 172.	Ongoing compliance

SCHEDULE 5 Long-nosed Bandicoots – Monitoring Requirements (Condition 167)

In accordance with Condition 167, the co-proponents are required to implement the monitoring program outlined in Table 6-9.

Table 6-9. Schedule 5 long-nose bandicoot monitoring requirements

Element	Timing	Methods
Bandicoot activity and use of foraging habitat	To commence within one month of the commencement date	Monitoring will be undertaken using spotlight transects and surveys of long-nosed bandicoot diggings on a three-monthly basis and will compare areas generally unaffected by the proposal (control areas) with areas potentially affected by the proposal (either by construction activities or visitors).
Any enhanced, reconstructed or rehabilitated habitat established in accordance with condition 165	To commence within one month of the works being completed	See above, but also to include identification of what use bandicoots are making of the enhanced habitat areas, i.e., foraging, shelter, nesting.
Deaths of Long-nosed Bandicoots attributable to vehicles. Road-deaths are taken to include any bandicoot remains identified on or next to roads	To begin within one month of the commencement date and to occur for the duration of the approval.	<p>Road-death monitoring shall be conducted by an appropriately trained and licensed person on a daily basis, within two hours of sunrise and is to be undertaken by driving set routes at slow speeds. Monitored roads are to include only internal roads of the Quarantine Station</p> <p>Road deaths are to be recorded on a publicly accessible mortality register, noting basic morphological details (age, sex and condition), the date, the name of the recorder, microchip number of the animal (if present) and the location plotted using a GIS-based map (see also conditions 169A and 66). For the purposes of road mortality monitoring an adult Long-nosed Bandicoot is defined as: female – 450 grams or heavier; male –heavier than 650 grams.</p> <p>Opportunities are to exist for the public to provide notification of road deaths that can be verified by a dead specimen or adequate photographic evidence. Where the cause of death or the age of the individual cannot be determined at the time of notification, the remains are to be collected and stored and a necropsy undertaken as soon as possible. Costs of the verification process shall be met by the co-proponents.</p>

SCHEDULE 6 - Long-Nose Bandicoots: Adaptive Management – Road Mortalities (Condition 169)

Boundary of road mortality monitoring - for the purposes of applying the following trigger mechanisms, Long-nosed Bandicoot- road mortalities are those adult mortalities recorded in accordance with the methods specified in Schedule 5 but only for internal roads of the Quarantine Station.

Table 6-10. Adaptive Management requirements

Element	Methods
Trigger 1	<p>If the level of private vehicle traffic generated by the proposal increases 10% above the projected levels, measures shall be introduced to reduce traffic volumes to below these levels and as close as possible to the original projections.</p> <p>Trigger 1 will apply regardless of whether the following triggers have been reached and vice versa (e.g. Trigger 2 could occur first, with Trigger 1 occurring at a later stage).</p>
Trigger 2	<p>If in any six-month period there are 2 recorded adult road mortalities above the background level (currently less than 2 adult deaths for any 6-month period) then the co-proponents must implement the following measures, unless otherwise agreed by the DEC:</p> <ul style="list-style-type: none"> + Seek approval from the relevant authorities (including Council if necessary) to install additional traffic calming devices and signage at appropriate locations within or outside of the site as informed by the mortality register (Schedule 5) and GIS (Condition 66); + Investigate the feasibility of providing roadside fencing to create defined road-crossing points for Long-nosed Bandicoots, particularly using the existing traffic calming devices; and + Reduce the frequency and alter the timing of functions, conferences and activities (e.g. scheduling finishing times of activities to minimise traffic leaving or arriving at the site after sunset). With the exception of any additional traffic calming devices, fencing and signage, the measures may be reversed with approval from the DEC if adult road deaths return to less than 2 above the background level for six consecutive months.
Trigger 3	<p>If the measures in Trigger 2 above have been applied and adult road mortalities continue to exceed 2 deaths above the background level for a further six months then the co-proponents shall also implement the following measures, unless otherwise agreed by the DEC:</p> <ul style="list-style-type: none"> + implement a sunset-to-sunrise curfew for overnight guest and day visitor private vehicles arriving at or leaving the site (including CP1 if at least half the mortalities have occurred outside of the site). During the curfew: <ul style="list-style-type: none"> ○ buses and coaches may continue to access the site in accordance with conditions 150) and 151); ○ the shuttle bus may continue to run from CPI to areas within the site; and ○ staff may continue to access and park in CP5 at all times; ○ provide a night shuttle bus service between Manly and the site (or some other means of public transport); and implement measures identified in the assessment of habitat reconstruction and rehabilitation options (condition 165) that have not already been undertaken.

Element	Methods
	<p>implement a total day and night ban on all guest and visitor private vehicles entering the site (including CP1 if at least half the mortalities have occurred outside the site). During the ban: provide a day and night shuttle bus service between Manly and the site (or some other means of public transport).</p> <ul style="list-style-type: none"> + The curfew must be implemented within 2 weeks of the six-month mortality information becoming available. The curfew may be lifted, and the shuttle bus service concluded with approval from the DEC once adult road mortalities return to less than 2 above the background level for six consecutive months.
<p>Trigger 4</p>	<p>If the measures in Trigger 3 above have been applied and adult road mortalities continue to exceed 2 deaths above the background level for a further six months then the co-proponents shall also implement the following measures, unless otherwise agreed by the DEC:</p> <ul style="list-style-type: none"> + buses and coaches may continue to access the site in accordance with conditions 150) and 151); + the shuttle bus may continue to run from CPI to areas within the site; and + if at least half the mortalities have occurred inside the site, staff may only park in CP1 (with no restrictions on timing) otherwise staff may continue to access and park in CP5 at all times; and + The ban must be implemented within 4 weeks of the six-month mortality information becoming available. The ban and associated restrictions may be lifted with approval from the DEC once adult road mortalities return to less than 2 above the background level for 12 consecutive months.
<p>Trigger 5 – potentially catastrophic events</p>	<p>If there are 10 adult road mortalities or more in any one-month period or 15 or more in any consecutive three-month period, then all the measures identified in Triggers 2, 3 and 4 shall be implemented, unless otherwise agreed by the DEC.</p> <p>Where these are inconsistent, the more restrictive of the measures is to apply).</p> <p>The measures must be implemented within 2 weeks of the mortality information becoming available. The measures may only be reversed with approval from the DEC if adult road mortalities are less than the background level for 12 consecutive months.</p>

6.2.6 Impact assessment

Monitoring indicates that the bandicoot population at North Head, including the QS lease area, has increased over time and stabilised and the sex ratio of individuals had evened in 2022.

Mortalities have not exceeded the minimum Trigger level 2 and NPWS are satisfied that the current mortality monitoring program and triggers are appropriate.

Based on available data and compliance reporting, the ongoing operation of the facility is considered unlikely to adversely affect the population.

6.2.7 Mitigation and management measures

Mitigation measures shall continue as per existing consent conditions.

Additional recommended measures outlined in Table 6-11 should be considered as improvement opportunities and are not in response to any adaptive management triggers.

Table 6-11. Long-nosed bandicoot recommended management and mitigation measures

Recommended measure	Rationale
CoPA 168 Adaptive management – foraging habitat monitoring.	
NPWS database be improved and updated on an annual basis	As per Section 6.1.7.1 (little penguin) recommendations, there is room for improvement and efficiencies in retrieving data when required, including GIS based mapping and shapefiles of monitoring locations.
CoPA 169A Adaptive management – road mortalities	
Consult with tertiary institutes to initiate trials of new and advancing technology designed to mitigate wildlife vehicle collisions.	<p>Advancing technology designed to mitigate wildlife vehicle collisions is being trialled relevant to: artificial intelligent powered camera monitoring to explore animal crossing behaviours; wildlife warning systems for drivers; and development of roadside repellents to discourage wildlife from entering roads at the wrong time.</p> <p>Research is being undertaken by tertiary institutes in collaboration with government and citizen science⁹ projects.</p> <p>Identifying future directions and opportunities and for research trials was the focus of a recent Symposium (Using Technology to Reduce Wildlife Vehicle Collion) held in Sydney, sponsored by Transport of NSW.</p> <p>The QS lease area and surrounding areas of the North Head NP and Sanctuary, along with a strong community interest, provides a unique location for trials to advance this technology.</p>

⁹ Citizen science is scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions (DCCEEW <https://www.environment.nsw.gov.au/research-and-publications/your-research/citizen-science/about-citizen-science>)

Recommended measure	Rationale
Light spill	
<p>Review lighting within proximal to bandicoot habitat to assess existing design parameters against current guidelines, standards and best practices, including but not limited to:</p> <ul style="list-style-type: none"> + National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds January 2020 Version 1.0. + International Dark-Sky and Australasian Dark Sky practices (https://www.australasiandarkskyalliance.org/best-practice-lighting). 	<p>Ensure mitigation of light spill impacts are updated to use the most recent advancements and guidelines since Outdoor Visitor Infrastructure was last updated in the last Infrastructure Control Plan (i.e. in 2008).</p>

6.3 Pseudophryne australis (red-crowned toadlet)

6.3.1 Description & distribution

Pseudophryne australis (the red-crowned toadlet) is an unmistakable small frog, usually measuring less than 30 mm long. It is dark brown to black, with distinctive reddish-orange patches, one between the eyes and one along the rump. It also has a white patch at the base of each arm. The belly is marbled black and white. The tadpoles are black and reach about 25 mm. The short, grating and "squelchy" call can be heard all year round (NSW TBDC).

The species has a restricted distribution being confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mount Victoria in the Blue Mountains (TBDC). Its range coincides with the Hawkesbury Sandstone geology of the Sydney Basin Bioregion including densely populated urban areas of Sydney. Known records are distributed in a belt around, but not on the Cumberland Plain. The range limits of the species have not been extended significantly despite intensive surveys in recent years (NSW Scientific Committee 2021).

6.3.2 Conservation

The red-crowned toadlet is currently listed as a vulnerable species on Schedule 2 of the BC Act. This status was assigned following a threat assessment of all vertebrate species in New South Wales (NSW) by Lunney et al. (2000). The species was considered vulnerable due to its low population size, low fecundity, habitat specialisation, low habitat availability, and that a large proportion of its range is affected by threatening processes (NSW Scientific Committee 2021).

They are conserved within National Parks throughout their range, including Bradleys Head, North Head and Dobroyd Head in Sydney Harbour, Berowra Valley, Blue Mountains, Brisbane Water, Bouddi, Dharug, Dharawal, Garigal, Heathcote, Ku-ring-gai Chase, Lane Cove, Manly Warringah War Memorial State Park, Murrumbidgee, Nattai and Royal National Parks.

In 2002 the Scientific Committee rejected a proposal to omit the red-crowned toadlet from Schedule 2 (Vulnerable Species) of the then TSC Act. The Scientific Committee were of the opinion that the species is likely to become endangered unless the circumstances and factors threatening its survival or evolutionary development cease to operate and is therefore eligible to remain listed as a Vulnerable Species.

6.3.3 Habitat requirements

The red-crowned toadlet shows considerable ecological specialisation. Unless otherwise referenced, the following information has been sourced from the environmental impact assessment guidelines (NPWS 2001) for the species.

All available evidence indicates that the species is restricted to the Triassic Hawkesbury and Narrabeen Sandstones of the Sydney Geological Basin. Habitat may be found in steep escarpment areas and plateaus, as well as low undulating ranges and outcroppings. Ironstone capping is a common feature of many sites where this species has been observed. Favoured microhabitats for shelter sites are under flat sandstone rocks ('bush-rock') either resting on bare rock or damp loamy soils. They have also been found under logs on soil, beneath thick ground litter and in horizontal rock crevices near the ground.

Within these geological formations, this species mainly occupies the upper parts of ridges, usually being restricted to within about 100 metres of the ridgetop. Although they also occur on plateaus or more level rock platforms along the ridgetop this area is usually less preferred than the first tallus slope areas below the upper escarpment or just below benched rock platforms.

Red-crowned toadlets usually live in the vicinity of permanently moist soaks or areas of dense ground vegetation or leaf litter along or near head-water stream beds. They prefer the first or second order ephemeral drainage lines commonly called 'feeder creeks' which drain the ridges, benches, cliffs and tallus slopes. These watercourses are often dry or reduced to ponded areas for much of the year and only sustain flow for short periods. Under natural conditions these feeder creeks have flows of high-water quality and low nutrient loads.

The principal vegetation community occupied by this species is Sydney Sandstone Ridgetop Woodland. Other vegetation communities recorded as representing this species' habitat (and that are present in the study area include): viz Sydney Sandstone Gully Forest (dominated by *Eucalyptus piperata*, *Eucalyptus pilularis* and *Angophora costata*, but utilised mainly at the ecotone between this community and the former, rather than in the gullies proper); Coastal Sandstone Heath community (dominated by *Banksia* spp., *Hakea teretifolia*, and *Baekea* spp.). Tree cover when present is usually open and low (10-20m), and the understorey is dominated by a complex range of xeromorphic shrubs.

The species deposits eggs in terrestrial nests beneath rocks and logs or in leaf litter. The toadlet relies on rainfall to wash the partially developed tadpoles into ephemeral creeks for completion of the reproductive cycle (NSW Scientific Committee 2021).

Potential habitat within the subject site would be present on moist sandstone benches or at the base of rock outcrops. Figure 6-12 shows the habitat areas that Gunninah (2001) suggested may provide habitat for the species and the location of records sourced from the TBDC threatened species search tool.

It should be noted that both records shown within the subject site are unlikely to represent the actual location where the species has been heard calling. One is from 1996 and reported as located within the gutter of the car park at the Ranger headquarters and where exposed rock shelves covered in parts by *Gleichenia* sp., (coral fern).

The second record from within the subject site is from March 2023, and the record to the east of the subject site is from June 2023. All records were 'heard' calls of the species.

The AWC surveys for the species at three locations within the northeast area of the headland and where hanging swamps have been maintained. These areas are relatively distanced from the subject site and may have been affected by the 2020 hazard reduction burns (that broke containment lines), as the species has not been recorded during biannual surveys following the fire (although its presence was heard incidentally during 2022 surveys).

6.3.4 Threats

Threats to the red-crowned toadlet listed in the TBDC, and the threat relevance is outlined below.

Clearing of habitat, particularly along ridges.	Threat is not present
Reduction in water quality flowing from ridges, particularly near urban areas	Managed in accordance with the Infrastructure Control Plan (ICP), which has been prepared to address a range of infrastructure including wastewater and stormwater management systems.
Bushrock removal	Threat is not present
Disease (chytrid fungus)	Potential to occur
Alteration of habitat structure, composition, resource availability caused by Climate Change	Threat present
Inappropriate fire regime and fire destroying key habitat	Fire regimes are managed by NPWS
Forest disturbance associated with forestry operations	Threat is not present
Disturbance to breeding habitat by recreational activity (e.g. bikes, 4WD)	Threat is not present

6.3.5 Impact assessment

There are no existing consent conditions that relate to the red-crowned toadlet. This is due to the MP SIS (Gunninah, 2001) concluding that:

- + The subject site does not provide optimal habitat for the species.
- + No potential (theoretical) habitat for the red-crowned toadlet areas would be affected.
- + The potential opportunistic use of artificial drains on the subject site cannot be regarded as critical for the species.
- + The proposal incorporates measures designed specifically to prevent contaminated runoff (Manidis Roberts EIS, 2001).
- + Consequently, the red-crowned toadlet is not considered an “affected species” with respect to the proposed activity.

As the species was considered unlikely to be present in 2001, there has not been any monitoring for the species within the subject site. Consequently, an assessment of the facility’s past operation as a guide to assessing impacts on the proposed ongoing assessment is not possible.

Notwithstanding, the ongoing operation of the facility is considered unlikely to adversely affect the red-crowned toadlet. Potential habitat for the species (as mapped by Gunninah in 2001 and shown in Figure 6-12) will not be subject to any changes in operational activities.

Key impacts on potential habitat for this species would be altered hydrology and activities that decrease water quality. The subject site’s hydrology will remain unchanged as will any activities that have the risk to impact on water quality.



Figure 6-12. Potential red-crowned toadlet habitat

6.3.6 Mitigation measures

It is recommended that ongoing monitoring programs be expanded to incorporate the red-crowned toadlet, which should at a minimum:

- + Validate and map potential areas of habitat,
- + Where necessary identify strategies to manage stormwater quality and quantity in habitat areas,
- + Consult with the AWC/Harbour Trust with regards to past incidental observations of the species,
- + In accordance with the NSW survey guidelines for threatened frogs (DPIE 2020), four (4) repeat surveys should be undertaken within areas of potential habitat (which can be surveyed all year round),
- + Include the species into the Integrated Monitoring and Adaptive Management System (IMAMS), and
- + Update Q Station's Information Management System updated accordingly.

6.4 Cercartetus nanus (eastern pygmy possum)

6.4.1 Description & distribution

Eastern pygmy-possums are tiny (15 to 43 grams) active climbers, with almost bare, prehensile (capable of curling and gripping) tails, and big, forward-pointing ears. They are light brown above and white below. Adults have a head and body length between 70 - 110 mm and a tail length between 75 - 105 mm.

The TBDC describes the species as occurring in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.

The species feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. It shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, ringtail possum dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.

The distribution of the eastern pygmy-possum extends from southern Queensland to eastern South Australia and Tasmania. In NSW it extends from the coast inland to the western slopes (e.g. Pilliga, Wagga Wagga. It is only found at higher elevations along the coast north of Newcastle.

Since 2016, 43 eastern pygmy-possums have been translocated to North Head (2016 = 8, 2017 = 10, 2018 = 7, 2019 = 6, 2020 = 3 and 2022 = 9). In 2022, individual eastern pygmy-possums were captured in 27 out of 101 nest boxes (total occupancy = 27%), with a mean occupancy per survey of 8.4% (± 3.8). This metric almost doubled from 2021 to 2022. The location of occupied nest boxes showed some variation in 2022 compared to previous years, with 20 boxes occupied for the first time. This suggests that eastern pygmy-possum are beginning to expand from initial release areas, thereby satisfying key success criteria associated with their reintroduction (AWC 2022).

6.4.2 Conservation status

The eastern pygmy possum is listed as vulnerable under the NSW BC Act but is not listed under the EPBC Act.

It is estimated that 45% of the pygmy possum’s NSW distribution is within conservation reserves (OEH 2015 – Saving Our Species). The species is known to be conserved in a number of National Parks, including: Royal, Heathcote, Jervis Bay, Budderoo, Morton, Dharawal and, Brisbane Waters, Marramarra, Blue Mountains, Kanangra-Boyd National Parks; Yerranderie SCA; and Barren Grounds, Dharawal, and Marramarra Nature Reserves.

6.4.3 Threats

Key recognised threats affecting the pygmy-possum and their relevance to the study area is outlined below.

Loss and fragmentation habitat through land-clearing for agriculture, forestry and urban development.	Threat is not present in QS lease area and wider North Head area – no further development is anticipated.
Changed fire regimes that affect the abundance of flowering proteaceous and myrtaceous shrubs, particularly banksias.	Fire regimes are managed by NPWS
Declining shrub diversity in forests and woodlands due to overgrazing by stock and rabbits.	Potential impact from rabbits. Managed by NPWS in accordance with the North Head QS Predator & Pest

	Control Plan (2008)
Predation from cats, dogs and foxes.	Managed by NPWS in accordance with the North Head QS Predator & Pest Control Plan (2008)
Loss of nest sites due to removal of firewood.	Threat not present
Mortality on roads through habitat and movement areas	Threat is present (refer to Section 6.4.4)

6.4.4 Impact assessment

The eastern pygmy possum was initially considered unlikely to be adversely affected by the proposed ongoing operation of the facility. This is largely due to the species having been introduced to the environment after operation of the facility had commenced. The pygmy possums introduced to nest boxes within or close to the subject site would have adapted to any potential indirect impacts (e.g., light, noise) from the facility’s operation.

However, during the preparation of this SIS a mother and young were killed in a vehicle strike within the QS lease area on the Entrance Road (shown as ‘Local Road’ in Figure 6-13). The location of the incident is where species occupancy has been recorded by AWC (refer Figure 6-14)



Figure 6-13. Eastern pygmy possum mortality

6.4.5 Mitigation measures

It is recommended that the monitoring and recording of eastern pygmy possum mortalities due to vehicle strike be included in the QS monitoring program and assessed on an annual basis.

This incident provides addition impetus to adopt the recommendation for the long-nosed bandicoot - CoPA 169A road mortality, which in summary is to:

- + Consult with tertiary institutes to initiate trials of new and advancing technology designed to mitigate wildlife vehicle collisions.

The rationale for this recommendation can be found in Table 6-11.

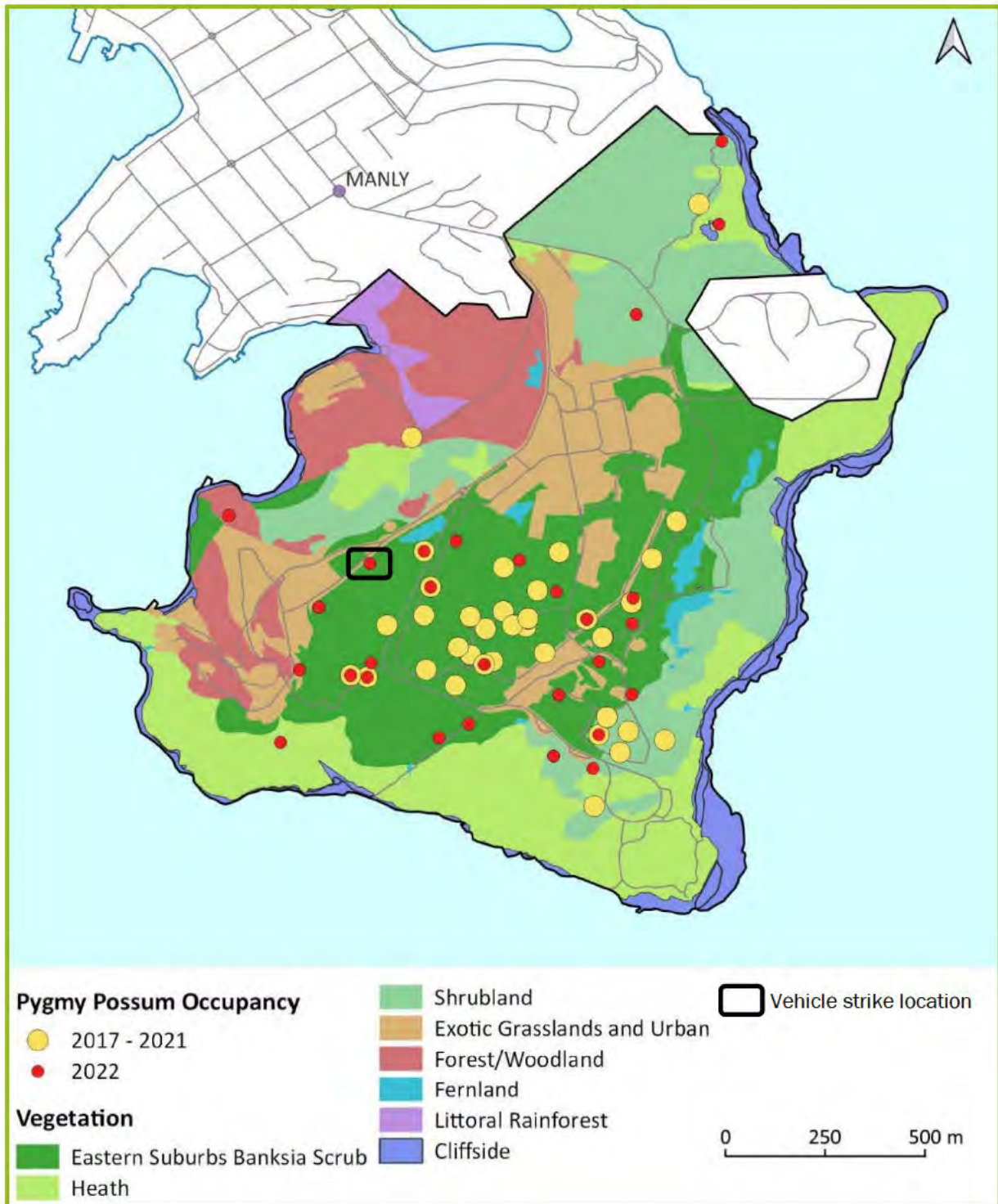


Figure 6-14. Eastern pygmy possum occupancy at North Head (source: AWC 2022)

7. Operations assessment

An assessment of the facility’s operation, current Site Wide Plans (as relevant to biodiversity) and additional measures recommended are summarised below in Table 7-1 and locations referenced are illustrated in Figure 2-1. All Site Wide Plans are referenced in the proposal’s REF.

Table 7-1. Operations assessment summary table

Operation	Management and mitigation measures	
	Site wide plans	Additional/recommended measures
Visitor access	<p>Endorsed:</p> <ul style="list-style-type: none"> + Visitor Management Plan, March 2005. + Travel and Access Plan 2018. <p>Draft:</p> <p>Refer mitigation measures in the Environment and Heritage Site Wide Management 2023: Appendix 10 Access Strategy Sub Plan (draft).</p>	<p>Consult with tertiary institutes to initiate trials of new and advancing technology designed to mitigate wildlife vehicle collisions.</p> <p>Threatened species monitoring program to Mortality register for long-nosed bandicoot to be updated to include eastern pygmy possum.</p>
Visitor management - site capacity	<p>Endorsed:</p> <ul style="list-style-type: none"> + Visitor Management Plan, March 2005. + Infrastructure Control Plan Part 1, 2008. <p>Draft: Refer to the Environment and Heritage Site Wide Management 2023:</p>	<p>Ensure mitigation of light spill impacts are updated to use the most recent advancements and guidelines</p> <p>It is recommended that lighting design for outdoor visitor infrastructure and buildings in the Wharf Precinct be reviewed and where applicable revised with consideration to the National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and</p>

Operation	Management and mitigation measures	
	Site wide plans	Additional/recommended measures
	<ul style="list-style-type: none"> + Appendix 10 Access Strategy Sub Plan (draft). + Appendix 6 Infrastructure Control Sub Plan (draft). 	migratory shorebirds January 2020 Version 1.0 (see Section 6.1.7).
Conferences, functions and events	<p>Endorsed:</p> <ul style="list-style-type: none"> + Visitor Management Plan, March 2005. + Noise Management Plan, 2005. <p>Draft: Refer to the Environment and Heritage Site Wide Management 2023:</p> <ul style="list-style-type: none"> + Appendix 10 Access Strategy Sub Plan (draft). + Appendix 12 Noise Management Plan (draft). 	Additional noise monitoring and sound reduction measures are recommended in Section 6.1.7 to fill existing knowledge gaps and provide additional protection to little penguin habitat (refer Section 6.1.7)
Food facilities and preparation	<p>Endorsed:</p> <ul style="list-style-type: none"> + Visitor Management Plan, March 2005. + Noise Management Plan, 2005. + Infrastructure Control Plan Part 1, 2008. + Predator and Pest Animal Plan, 2008. <p>Draft:</p>	Additional noise monitoring and sound reduction measures are recommended in Section 6.1.7 to fill existing knowledge gaps and provide additional protection to little penguin habitat (refer Section 6.1.7)

Operation	Management and mitigation measures	
	Site wide plans	Additional/recommended measures
	<p>Refer to the Environment and Heritage Site Wide Management 2023:</p> <ul style="list-style-type: none"> + Appendix 10 Access Strategy Sub Plan (draft). + Appendix 12 Noise Management Plan (draft). + Appendix 6 Infrastructure Control Sub Plan (draft). + Appendix 9 Predator and Pest Control Sub Plan (draft). 	
Staff and training	<p>Endorsed:</p> <ul style="list-style-type: none"> + Visitor Management Plan, March 2005. + Noise Management Plan, 2005. + Infrastructure Control Plan Part 1, 2008. + Predator and Pest Animal Plan, 2008. <p>Draft: Refer to the Environment and Heritage Site Wide Management 2023:</p> <ul style="list-style-type: none"> + Appendix 10 Access Strategy Sub Plan (draft). + Appendix 12 Noise Management Plan (draft). 	<p>At the beginning of employment all staff must complete an induction training session and driver induction if driving on site.</p> <p>Maintenance staff are to undertake regular induction and training in relation to threatened species habitat and their location.</p>

Operation	Management and mitigation measures	
	Site wide plans	Additional/recommended measures
<p>Environmental</p> <p>Maintenance/conservation</p>	<p>Endorsed:</p> <ul style="list-style-type: none"> + Heritage Landscape Management Plan, 2005 + Visitor Management Plan, March 2005. + Noise Management Plan, 2005. + Infrastructure Control Plan Part 1, 2008. + Predator and Pest Animal Plan, 2008. + Erosion and sedimentation control plan, 2005. <p>Draft: Refer to the Environment and Heritage Site Wide Management 2023:</p> <ul style="list-style-type: none"> + Appendix 18 Outdoor Visitor Infrastructure Sub Plan (draft). + Appendix 12 Noise Management Plan (draft). + Appendix 6 Infrastructure Control Sub Plan (draft). + Appendix 9 Predator and Pest Control Sub Plan (draft). + Appendix 11 Erosion and Sedimentation Control Sub Plan (draft). 	<p>Sound reduction barriers are recommended to provide additional protection to the little penguin breeding habitat adjacent to the Boilerhouse Restaurant.</p> <p>Little penguin habitat at northern end of QS Beach - Fencing does not provide penguin access to habitat reported to occur further south of fenceline.</p> <p>Leaf litter at fence has choked any ground access further south, which needs to be ameliorated and monitored on a regular basis.</p> <p>Habitat enhancement and artificial nest installations to be undertaken in consultation with specialists.</p>

8. Assessments of Significance

8.1 Overview

The objective of the assessment of impacts on biological diversity (biodiversity) is to enable decision-makers to ensure that developments deliver the following environmental outcomes:

- + Maintain or improve biodiversity values (i.e. there is no net impact on threatened species or native vegetation)
- + Conserve biodiversity and promote ecologically sustainable development
- + Protect areas of high conservation value
- + Protect the long-term viability of local populations of a species, population or ecological community and prevent their local extinction (extirpation).

Assessments must be consistent with the test of significance for the relevant species, population or community as required by the relevant legislation.

- + For entities listed under the BC Act (including populations listed under the former TSC Act), the test requires consideration of the factors outlined in s.7.3 of the BC Act and is known as the '5-part test' – refer to the NSW Threatened Species' Test of Significance Guidelines.
- + For entities listed under the FM Act, the test requires consideration of the factors outlined in s.221ZV of the FM Act and is known as the '7-part test' – refer to the Threatened Species Assessment Guidelines: The assessment of significance.
- + For entities listed under the EPBC Act, the significant impact criteria vary according to the category of listing as outlined in the relevant chapter of the Matters of National Environmental Significance: Significant impact guidelines 1.1.

8.2 Significance of impacts framework in NSW

Section 7.2 of the BC Act provides that development under the EP&A Act is likely to significantly affect threatened species if:

- a. it is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in section 7.3 of the BC Act (test of significance), or
- b. the development exceeds the biodiversity offsets scheme threshold if the biodiversity offsets scheme applies to the impacts of the development on biodiversity values, or
- c. it is carried out in a declared area of outstanding biodiversity value.

For an activity under Part 5 of the EP&A Act clause (b) does not apply, so an activity will only be likely to significantly affect a threatened species if:

- a. it is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test of significance, or
- b. it is carried out in a declared area of outstanding biodiversity value.

For an activity under Part 5, an assessment of an activity that is likely to significantly affect a threatened species must be accompanied by a species impact statement.

As already discussed in Section 1.3, parts of the subject site are located in critical habitat for the endangered little penguin (*Eudyptula minor*) population at Manly and the requirement for this Species Impact Statement (SIS) is therefore triggered.

8.2.1 Test of Significance (BC Act)

Table 8-1 lists the threatened species and populations listed in under the BC Act for which the following (Test of significance) factors has been considered based on information provided in Sections 4, 5 and 6 of this SIS).

- a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction [BC Act section 7(1)(a)]
- b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
 - i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
 - ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction [BC Act section 7(1)(b)]
- c. in relation to the habitat of a threatened species or ecological community:
 - i. the extent to which habitat is likely to be removed or modified because of the proposed development or activity, and
 - ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat because of the proposed development or activity, and
 - iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality [BC Act section 7(1)(c)]
- d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly) [BC Act section 7(1)(d)]
- e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process [BC Act section 7(1)(e)]

Table 8-1. Test of significance summary

Threatened species and populations	Test of significance question (Y/N)					Likely significant impact?
	a	b	c	d	e	
<i>Acacia terminalis</i> subsp. <i>terminalis</i> sunshine wattle	N	N	N	N	N	NO
<i>Eucalyptus camfieldii</i> Camfield's stringybark	N	N	N	N	N	NO
Population of Little Penguins <i>Eudyptula minor</i> at Manly	N	N	N	Y ^{#10}	Y ¹¹	NO

¹⁰ Medium or high impact levels are likely to occur to AOBVs if any physical or chemical changes to the environment identified as AOBV may result. The proposal will not result in any physical or chemical changes to the habitat of little penguins (refer to Section 6.1 for further detail and impact assessment for this species).

¹¹ Only part of the proposal would represent a KTP

Threatened species and populations	Test of significance question (Y/N)					Likely significant impact?
	a	b	c	d	e	
Population of Long nosed Bandicoots <i>Perameles nasuta</i> at North Head	N	N	N	N	N	NO
<i>Pseudophyrne australis</i> red-crowned toadlet	N	N	N	N	N	NO
<i>Cercartetus nanus</i> eastern pygmy possum	N	N	N	N	N	NO

8.3 Fisheries Management Act

Under the *Fisheries Management Act 1994* (FM Act) Section 221ZV the following has been considered for the purposes of determining under this Division whether a proposed development or activity is likely to significantly affect the seagrass *Posidonia australis* Endangered Populations in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW).

- a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable see (b)

- b. in the case of an endangered population, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

A review of past surveys conducted on behalf of Mawland (the former Q Station lessee), collection of 2003 benchmark data and development of the approved seagrass monitoring program undertaken by Marine Pollution Research Pty Ltd (MRP) there is currently no indication of any significant reduction in the density, extent or condition of the seagrass beds that can be associated with operation of Q Station.

- c. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity— (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable

- d. in relation to the habitat of a threatened species, population or ecological community—
- i. the extent to which habitat is likely to be removed or modified because of the proposed development or activity, and
 - ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat because of the proposed development or activity, and
 - iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the threatened species, population or ecological community in the locality,

Based on MRP findings the extent of habitat will not be removed or modified, isolated from other habitat areas because of the proposed ongoing operation of the facility.

The habitat proximal to the subject site is approximately 0.7ha of seagrass which includes *Posidonia*, *Zostera* and *Halophila* species. Based on DPI 2008 mapping, in Sydney Harbour there is approximately 9.73 ha of seagrass habitat that includes *Posidonia*:

Posidonia	2.43 ha
Posidonia/Zostera	4.13 ha
Posidonia/Zostera/Halophila	3.17 ha
Subtotal Sydney Harbour	9.73 ha

The habitat proximal to the subject site is estimated at 7.3% of all *Posidonia* and mixed *Posidonia* seagrass patches in Sydney Harbour and approximately 1.2% of all *Posidonia* and mixed *Posidonia* seagrass patches within the endangered populations total extent (also based on 2018 mapping).

e. whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly)

Critical habitat has not been declared for this population.

f. whether the proposed development or activity is consistent with a Priorities Action Statement,

The proposed ongoing operation of the facility is not inconsistent with the population's Priorities Action Statement, which includes the following themes:

- Advice to consent and determining authorities
- Collate and review existing information
- Community and stakeholder liaison, awareness and education
- Compliance / enforcement
- Enhance, modify or implement NRM planning processes to minimise adverse impacts on threatened species
- Habitat rehabilitation
- Pest eradication and control
- Research / monitoring
- Survey / mapping

The approved monitoring program (MRP 2023) supports the survey / mapping priority action which states: collect data on the presence/absence of *Posidonia australis* during incidental surveys.

g. whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The Fisheries Scientific Committee identified many causes for the declines in extent of *Posidonia australis*, including: direct physical damage from dredging, sand mining, reclamation, boat moorings, boat propellers, bait gathering and from changes to the physical environment (e.g., wave heights); and losses at some locations due to anthropogenic changes in water quality, particularly increased nutrients and reductions in water clarity; as well as the invasive pest alga *Caulerpa taxifolia*.

Boat mooring is prohibited in the Spring Cove seagrass habitat areas, vessels are required to limit speed to 4 knots or below.

Berthing at the Q Station wharf is also conditioned to minimise disturbance to seagrass, which includes:

- docking only at the head of the wharf (i.e. the north-western end)
- until such time as any future alterations to the wharf have been assessed and approved by the relevant authorities the ferry shall not moor at the wharf when not in active use (i.e. overnight)

- the ferry shall not moor at the wharf during unsuitable weather events (e.g., storms, strong winds, large swells)
- no vessel access on the south-western side of the wharf, parallel to Cannae Point

Conclusion: based on available data and investigations (MRP 2023) and information (DPI Fisheries, Fisheries Scientific Committee) it is concluded that the proposed ongoing operation of the facility will not significantly impact on the *Posidonia australis* endangered population.

Implementation of the approved seagrass monitoring program (MRP 2023) will be important in discriminating potential effects from the proposal against external impacts (such as waves and boat/ferry wash beyond Spring Cove).

8.4 Matters of National Environmental Significance

Matters of National Environmental Significance (MNES) that occur within the subject site include those listed in Table 8-2.

Table 8-2. MNES identified in the subject site

MNES	Status
Littoral Rainforest and Coastal Vine Thickets (PCT 3040 Sydney Coastal Foreshores Gully Rainforest)	Critically endangered
Eastern Sydney Banksia Shrubland (PCT 3805 Southern Sandplain Heath and PCT 3806 Sydney Coastal Sand Mantle Heath)	Critically endangered
The <i>Posidonia australis</i> seagrass meadows of the Manning-Hawkesbury ecoregion ecological community	Endangered
<i>Acacia terminalis</i> subsp. <i>terminalis</i> sunshine wattle	Endangered
<i>Eucalyptus camfieldii</i> Camfield’s stringybark	Vulnerable

The MNES Significant impact guidelines 1.1 (Commonwealth of Australia 2013) assist in undertaking an assessment to decide whether an action is likely to have a significant impact on any MNES.

Significant impact criteria for critically endangered ecological communities - Littoral Rainforest and Coastal Vine Thickets and Eastern Suburbs Banksia Scrub of the Sydney Region

An action is likely to have a significant impact on a critically endangered ecological community if there is a real chance or possibility that it will:

- + reduce the extent of an ecological community
- + fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
- + adversely affect habitat critical to the survival of an ecological community
- + modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community’s survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
- + cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

- + cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
 - assisting invasive species, that are harmful to the listed ecological community, to become established, or
 - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or
- + interfere with the recovery of an ecological community.

Assessment:

The proposed ongoing operation of the facility does not involve any direct or indirect impacts that would adversely affect habitat of Littoral Rainforest and Coastal Vine Thickets and Eastern Suburbs Banksia Scrub of the Sydney Region.

No clearing of vegetation is proposed and no changes in current management and maintenance activities are proposed that would reduce the quality or integrity of these communities or interfere with the recovery of these communities.

Ongoing weed management associated with the facility's operation would have a positive impact on these communities.

Significant impact criteria for endangered species - *Acacia terminalis* subsp. *terminalis* sunshine wattle

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- + lead to a long-term decrease in the size of a population reduce the area of occupancy of the species
- + fragment an existing population into two or more populations adversely affect habitat critical to the survival of a species
- + disrupt the breeding cycle of a population modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- + result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat
- + introduce disease that may cause the species to decline, or
- + interfere with the recovery of the species.

Assessment:

The proposed ongoing operation of the facility does not involve any clearing of vegetation and therefore there will be no anticipated direct impacts on the sunshine wattle.

No changes in current management and maintenance activities are proposed that would reduce the quality or integrity of these communities or interfere with the recovery of the species.

Ongoing weed management associated with the facility's operation would have a positive impact on these communities.

Mandatory induction and ongoing training and review will be undertaken to ensure that the location and identification of the species is known to all landscape personnel and contractors engaged to work in or near locations where the species occurs.

Significant impact criteria for vulnerable species - *Eucalyptus camfieldii*

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- + lead to a long-term decrease in the size of an important population of a species
- + reduce the area of occupancy of an important population
- + fragment an existing important population into two or more populations
- + adversely affect habitat critical to the survival of a species
- + disrupt the breeding cycle of an important population
- + modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- + result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
- + introduce disease that may cause the species to decline, or
- + interfere substantially with the recovery of the species.

***E. camfieldii* assessment:**

E. camfieldii occurs as three individual specimens located within and adjacent to the subject site and does not constitute an important population of the species.

Notwithstanding, the proposed ongoing operation of the facility does not involve any clearing of vegetation or changes in current management and maintenance activities that would reduce the quality or integrity of *E. camfieldii* habitat, introduce invasive species or disease, or interfere with the recovery of *E. camfieldii*.

Ongoing weed management associated with the facility's operation would have a positive impact on habitat for *E. camfieldii* and induction and training (as per the sunshine wattle) will ensure inadvertent disturbance or damage to the *E. camfieldii* specimens occur.

8.5 Marine Estate Management Act

Lands immediately adjacent to, or in the immediate proximity of, the coastal waters of the State that are subject to oceanic processes (including beaches, dunes, headlands and rock platforms) are defined as "marine estate" is defined under the *Marine Estate Management Act 2014*.

Within the subject site, this includes QS Beach up to the highest astronomical tide, which is also identified as an aquatic reserve categorised as IUCN IV.

The proposed ongoing operation does not seek approval for development within the aquatic reserve. However, Section 56 (3) of the *Marine Estate Management Act 2014* requires the following:

A determining authority must not carry out, or grant an approval to carry out, an activity on land that is in the locality of a marine park or an aquatic reserve in purported compliance with Part 5 of the EP & A Act unless:

- a. the determining authority has taken into consideration the purposes of marine parks or aquatic reserves, the regulations and any advice given to it by the relevant Ministers on the impact on the marine park or aquatic reserve of the carrying out of an activity in the locality, and

- b. if the determining authority is of the opinion that the proposed activity is likely to have an effect on the plants or animals within the marine park or aquatic reserve or their habitat, the determining authority has consulted with the relevant Ministers.

Aquatic reserve IUCN IV relates to a habitat or species management area. Category IV areas are to be sufficiently controlled to ensure the maintenance, conservation, and restoration of particular species and habitats—possibly through traditional means—and public education of such areas is widely encouraged as part of the management objectives.

The subject site is located adjacent to the North Harbour Aquatic Reserve, which has boundaries formed by a line between headlands at North Head and Grotto Point, and another line joining Little Manly Point, Manly Point and Forty Baskets Beach and extends from the seabed at these outer boundaries up to the mean highwater mark.

Within the reserve adjacent to the subject site, the following regulations apply:

- + Spearfishing is prohibited at all times
- + Fishing is prohibited in the little penguin critical habitat areas from sunset to sunrise 1 July to 28 February (inclusive).
- + Fishing for fin fish by hand held line only is permitted excluding from sunset to sunrise 1 July to 28 February (inclusive). Fishing bait must be brought to the reserve (see below).
- + Except for fin fish, the taking, gathering, destruction, injury or interference with any fish or marine vegetation (whether dead or alive) is not permitted. This includes a prohibition on the killing of cunjevoi or invertebrates to feed fish or for use as bait.

The above regulations do not apply to the proposed ongoing operation of the facility.

Additional maritime regulations are in place that include: a 4knot water vessel speed limit to minimise potential vessel strike impacts to little penguins; no-anchoring zones in Spring Cove to protect seagrass beds; and vessel berthing protocols in place at the Q Station wharf to minimise disturbance to seagrass beds.

8.6 Conclusions & Recommendations

8.6.1 Conclusions

Based on the information available at the time of preparing this SIS the following is concluded:

- + The proposed ongoing operation of Q Station will not result in significant impacts on biodiversity values within or proximal to the subject site.
- + The risk of any potential impacts having a significant impact on biodiversity values (within the subject site or proximal to the subject site) appears due to external factors that are beyond the control of NHS (e.g., climate change, wave action from the busy harbour, unplanned bushfires, recreational visitors by watercraft to Spring Cove).
- + The potential for the proposal to result in any impacts on biodiversity values will be continually monitored and scrutinised through ongoing compliance auditing and where necessary adaptively managed.

8.6.2 Recommendations

The following recommendations are provided for integration into the existing monitoring programs and for consideration in consultation with relevant regulatory authorities:

- + Validation of the boundaries and condition of plant community types within the subject site to determine the extent and type of threatened ecological communities, guide how they should be

managed, and understand whether diagnostic and condition thresholds are met to be considered nationally threatened.

- + Staff induction, ongoing training and records requirement for all employees and contractors working in habitat areas of threatened species, communities and populations – to be updated to include eastern pygmy possum and red-crowned toadlet.
- + Ongoing monitoring programs be expanded to include the red-crowned toadlet.
- + In consultation with the NPWS little penguin recovery team investigation options to re-introduce nest boxes at QS Beach for the little penguin.
- + Consult with NSW TfNSW (Maritime) to:
 - o improve signage in Spring Cove and enforcement of speed limits and anchoring in no-anchor zones (noting that aerial photographic interpretation indicates multiple infringements)
 - o undertake educational/information campaigns to commercial operators and private boat owners to reinforce the sensitivity of the Spring Cove environment.

9. Additional Information

9.1 Qualifications and experience

The qualifications and experience of the author, Kathryn (Kat) Duchatel, of this SIS is provided below:

- + BSc Env (Macquarie)
- + BAM Assessor Accreditation no: BAAS17054
- + EIANZ Certified Environmental Practitioner
- + Ecological Consultants Association of NSW Practicing member
- + Fisheries scientific collection permit - Section 37 of the FM Act (P20/0008-1.0)
- + Biodiversity conservation licence - Part 2 of the BC Act (SL102722)

Kat has over 25 years' experience in the assessment, planning and management of the natural environment. Her formative years were cultured under the guidance of Australian wetland authority and technical publisher, Geoff Sainty (Sainty & Associates Pty Ltd). During this time Kat was exposed to, and worked alongside, an enviable range of Australian specialists in the fields of biodiversity, land management and water resources.

Her understanding of development approvals was thereafter refined through her employment over ten years with global engineering and environmental companies (AECOM and MWH Global now Stantec). Since forming écologique, Kat continues to work to the very high standards she has set herself and is well respected in her field.

Kat is an accredited biodiversity assessor under Section 6.10 of the BC Act and previously accredited as a Biobanking assessor under the repealed Threatened Species Conservation Act 1995 (TSC Act).

Relevantly, Kat has undertaken a diverse range of biodiversity impact assessments including biodiversity development assessment reports (BDARs), application of the Biodiversity Assessment Method (BAM, 2020), Commonwealth referrals under the EPBC Act.

9.2 Other approvals required for the proposal

This SIS will be lodged to NPWS in conjunction with the Review of Environmental Factors (REF) for the ongoing operation of the facility, prepared by Keylan.

Section 110(5) reports - relevant threatened species profiles, scientific committee final determinations, conservation advice and environmental impact assessment guidelines were consulted in the compilation of this report (see Section 1.3.2 and Section 8).

Relevant additional legislation has been discussed in Section 8.

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